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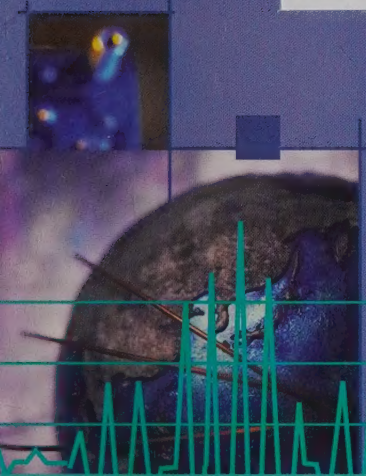
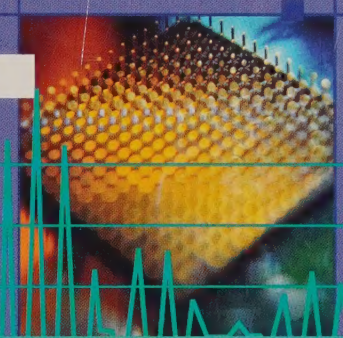
Optical Multimeter
Instruction Manual





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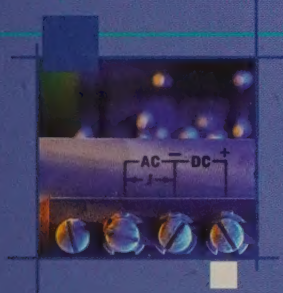

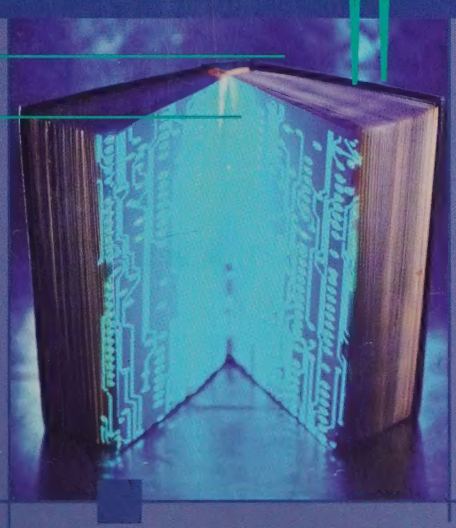

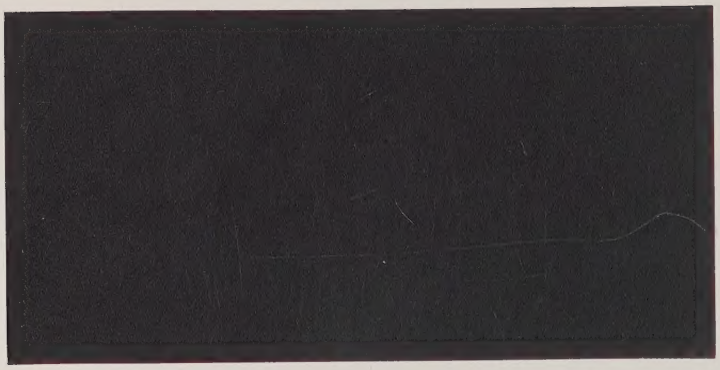

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AQ2140 Optical Multimeter
Instruction Manual

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AS-62333 Rev. 1.2

MEANING AND USAGE OF SIGNIFICANT DESCRIPTION

The following explains meanings and usages of significant descriptions to be occasionally found in this manual:

DEFINITION AND USAGE OF TERMS USED IN THIS MANUAL

Following section defines the terms and their usage used in this instruction manual.

1. Dangers, Warnings, Cautions, and Notes

   (1) Priority of hazard information
   The priority of hazard information is as follows:
   Dangers > Warnings > Cautions > Notes

   (2) Meanings of hazard information

   DANGER: Identifies immediate hazards that will result in death or severe personal injury. This is the highest priority hazard identification marking.

   WARNING : Identifies hazards or unsafe practices that can result in severe personal injury.

   CAUTION: Identifies hazards or unsafe practices that can result in damage to system units or can "interrupt" system operations.

   Note: Identifies an auxiliary information about exceptional rules, corrections, and restrictions.

2. Reference Pages

   The page or pages that you should refer to are shown.
   An example of "See Page 2-1".

3. Pictorials of Operation Keys

   This manual shows the system operation keys as follows:

   [ ] : Indicates a key top character.
   [ ] : Indicates a front panel or rear panel name.

- Read this manual and the precautions for safety in it carefully before using the device.
- Maintain this manual at a location easy to access.

Precautions for Safety

1. Restrictions on use environments

- Take care so that water may not get into the device or the device may not be exposed to water. Such could cause fire, electrical shock or device trouble.
- Provide grounding connection when using the device in highly humid environment.

2. Restrictions on Use Conditions

- Use the device only at the voltages indicated on the marking. Using the device off the specified voltages could result in fire, electrical shock or device trouble.
- When using supply mains, the device must be connected directly to the dedicated plug socket. Do not use an extension cord because it can cause heat build up or firing.

3. Erection and installation

3.1 Notes for personnel in charge of erecting and installing the device

- Avoid putting many loads on one electrical outlets. Such could cause firing or heat build up.
- Power plug must be securely inserted to the plug socket. Fire or electrical shock may be caused if the power plug blade is contacted against metals.

3.2 Restrictions and prohibitions on the installing environments and conditions

- Do not install the device in humid or dusty environment. Such environment can cause electrical shock or device trouble.
- Do not erect the device in an unstable place such as shaky bench or inclined location. That could cause personal injuries if the device has fallen or tumbled down.
- Avoid environment of high vibration or shock. Personal injuries could result if the device has fallen or tumbled down.
- Take care so that metals may not be dropped or inserted into the device through its openings. Such could cause fire, electrical shock or device trouble.
- Do not the place power cord near to heat generating equipments. Fire or electrical shock can result if coating on the cord melts away.

- When pulling out the power plug, hold the plug instead of cord. Otherwise the cord can be damaged possibly resulting in fire or electrical shock.
- Don not insert or pull out the power plug when your hands are wet. Electrical shock might result.
- Do not install the device in a high temperature environment or a place exposed to direct sun. Fire might develop due to internal heat build up.

3.3 Prohibitions on the installation

- When moving the device, make sure that the power plug has been pulled out of the plug socket and the external connection wire has been removed. Damaged cord can cause fire or electrical shock.
- Make sure that ventilating hole on the device is not clogged. Such could cause internal heat build up and might result in fire.
- Take care so that the power cord may not be damaged or broken. Do not try to rework the power cord. Avoid placing the cord under a heavy load, heating it or pulling it forcibly. Damaged cord can cause fire or electrical shock.

4. Preparation before Use

- Read the instruction manual carefully.

5. Device Operation

- Read the instruction manual carefully.
- When the warning making (Note, Warning or Danger) is provided, operate the device according to the instructions given the instruction manual.
- If the light source is controlled or adjusted off the procedures, hazards such as exposure to highly dangerous laser beam can result. Handling of optical equipmwnts such as lenses require caution because they can give adverse effects to your eyes.
- Do not place containers filled with water or small metals near the device. If such is spilt or falls into the device, fire, electrical shock or device trouble can be caused.
- Do not try to rework the power cord. And, do not try to bend, twist or pull it forcibly. Such could result in fire or electrical shock.
- Do not try to disassemble or rework the device. Such can be a cause of fire, electrical shock or device trouble.
- When the device is not to be used for a long time, the power plug must be removed from the plug socked. This is for safety. Otherwise, fire, electrical shock or device trouble can result if struck by lightning.

6. Maintenance and Inspection

- Implementation of periodical maintenance and inspection are recommended. If dusts inside the device are not cleaned for a long time, fire or device trouble can be caused. Refer to the list of our offices attached at end of this manual and contact the office most convenient to you.

7. Troubleshooting Guide

- Damaged power cord must be replaced. Such cord can cause fire or electrical shock.
- If inside of the device has been contaminated by foreign substance, turn the body power switch off, pull the power plug out of plug socket and contact us. If the device is used in such state without any proper actions, fire, electrical shock or device trouble can be caused.
- If smoke or offensive odor is detected on the device, turn the power switch off immediately, pull the power plug out of plug socket and contact us for repair making sure that smoke has been eliminated. If you use the device in such abnormal state, fire, electrical shock or device trouble might be caused. Do not try to fix the trouble by yourself. It will be extremely dangerous.
- If the device is dropped or damaged, turn the body power switch off, pull the power cord out of plug socked and contact us. If the device is used without any proper action, fire, electrical shock or device trouble might be caused.

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1. System Overview

This manual describes how to operate your AQ2140 Optical Multimeter (called the "AQ4240" hereafter) correctly.

1.1 System Outline

The AQ2140 is a two-channel, general-use controller that supports an easy plug-in unit replacement. However, you must connect only the dedicate Sensor Units and Light Source Units to the AQ2140. You cannot use the conventional optical units for the AQ2140.

By connecting two sensor units to your AQ2140, you can measure the optical power of two DUTs (devices under test) simultaneously. Also, by connecting a single Sensor Unit and an Light Source Unit to the AQ2140, you can easily measure the optical signal transmission loss.

1.2 Specifications

Table 1-1 gives the standard specifications of the AQ2140.

1.3 System Configuration

The standard system consists of the AQ2140 itself and the accessories listed on the following table.

List of standard system accessories

No.	Accessory Name	Quantity	Remarks
1	Instruction manual	1	
2	Blank panel	1	Mounted on the unit accommodation location.
3	Modular connector dust cover	1	Mounted on [EXT UNIT] of the rear panel.
4	Power cord	1	A three-pole power cord (with a three-to-two pole conversion adapter)

Table 1-1 Specifications of AQ2140 Optical Multimeter (1/2)

Display intensity control	One of four intensity levels (100%, 75%, 50% or 25% intensity) is selectable.
Beep volume control	One of five tone levels (100%, 75%, 50%, 25% or 0%) is selectable.
Beep tone control	One of 16 tones is selectable.
Measurement display	The 7-segment (5 and a half digit) fluorescent lamp display with a 13-dot bar graph
Display units	Absolute values: dBm, mW, μW, nW, pW Relative values: dB, ratio (without unit)
Relative value measurement	Relative measurement (DREF) based on the on-screen display values Relative measurement (A/REF or B/REF) based on the reference set values Comparison between channels (A/B or B/A)
Calibration coefficient	The sensor wavelength sensitivity is corrected (at 1-nm step), or "CAL F" input using the relative value (in dB).
Range switching	Automatic or fixed measurement range (It can be increased or decreased by UP/DOWN keys during fixed range measurement.)
Optical modulation mode	CW or CHOP modulation mode (270 Hz, 1 kHz or 2 kHz) can be switched.
Measurement interval	10 (20), 50, or 100 msec is selectable. (*1)
Averaging	Sequential additional averaging (by selecting 2/5/10/20/50/100/200 times). It can be turned ON or OFF.
Display resolution	0.1, 0.01, or 0.001 is selectable.
Measuring condition setup	Up to 10 measuring conditions can be stored. (However, one of them is fixed to the initial value and it cannot be changed.)
Data holding	The maximum, minimum, and differential values of measurement are displayed.
Optical attenuation	Maximum attenuation amount: 6.0 dB (at 0.1 dB step)
Plotter function	The memory data can be plotted to a graph and output to an external plotter. (*2)
Data storage	Up to 1000 data sets can be stored in memory.
GPIB interface	The IEEE-488 interface standards are satisfied.

Table 1-1 Specifications of AQ2140 Optical Multimeter (2/2)

Power supply	100 to 240 VAC, 48 to 63 Hz
Power consumption	Up to 80 VA
Ambient temperature	Operating temperature: 0 to +50°C (Constant temperature: –25 to +70°C, Humidity: 85% or less)
Dimensions and weight	213W × 88H × 350D mm, approximately 3 kg

(*1) The maximum measurement interval is 20 msec when two Sensor Units are attached.

(*2) Supported plotters are Graphtec's GD9411F and GD9411 plotters having the GPIB interface.

Table 1-2 Specifications of Sensor Units

Sensor unit		AQ2732	AQ2733	AQ2734	AQ2735
Wavelength range		700 to 1700 nm		900 to 1870 nm	700 to 1700 nm
Photosensor element		InGaAs	Cooled InGaAs		
Signal input format		By use of standard AQ9389B (FC) connector adapter			
Polarization dependency (*1)		0.02 dBp-p (Typical)	0.02 dBp-p or less		0.02 dBp-p (Typical)
Power range (*2)	CW light	–80 to +10 dBm (10 pW to 10 mW)	–110 to +10 dBm (0.01 pW to 10 mW)	–90 to +3 dBm (1 pW to 2 mW)	–80 to +27 dBm (10 pW to 0.5 W)
	CHOP light	–90 to +7 dBm (1 pW to 5 mW)	–110 to +7 dBm (0.01 pW to 5 mW)	–90 to +0 dBm (1 pW to 1 mW)	–80 to +24 dBm (10 pW to 0.25 W)
Uncertainty at reference conditions (*3)		±2.5% at 1310-nm calibration point			
Total uncertainty (*4)		±5% (1000 to 1600 nm)	±5% (1000 to 1650 nm)	±5% (1200 to 1700 nm)	±5% (1000 to 1650 nm)
Linearity at fixed temperature (23 ±5°C) (*5)		±0.05 dB (–50 to +10 dBm)	±0.05 dB (–70 to +10 dBm)	±0.05 dB (–60 to +3 dBm)	±0.05 dB (–40 to +27 dBm)
Noise level (*6)	CW light	–73 dBm or less	–93 dBm or less	–83 dBm or less	–73 dBm or less
	CHOP light	–83 dBm or less	–93 dBm or less	–83 dBm or less	–73 dBm or less

(*1) Measured at 1550 nm wavelength

(*2) Measured at 1310 nm wavelength

(*3) Reference conditions

(1) Power level: –20 dBm (10 μW), CW

(2) 10-μm optical fiber, master FC connector

(3) Ambient temperature: 23±5°C (23±1°C for AQ2732)

(4) When calibrated with the AQ9389B (FC) connector adapter

(*4) Operating conditions

(1) Power level: –20 dBm (10 μW), CW

(2) 50μm or less optical fiber: NA < 0.2

(3) Ambient temperature: 23±5°C (23±1°C for AQ2732)

(4) When calibrated with the AQ9389B (FC/SC) connector adapter

(*5) (1) Linearity of any single wavelength within the wavelength operating range defined by the total measurement accuracy.

(2) CW; 23±1°C for the AQ2732

(*6) (1) Averaging: 1 sec (100 msec measurement interval, 10 time averaging)

(2) The wavelength operating range is the same as the total measurement accuracy.

Table 1-3 Specifications of LD Unit

Unit		AQ4211 (131)	AQ4211 (155)	AQ4213 (131/155)
Center wavelength (*1)		1310±20 nm	1550±20 nm	1310±20 nm/1550±20 nm
Spectrum half width (*1, *2)		5 nm or less	10 nm or less	5 nm or less/ 10 nm or less
Optical output level (*1)		0 dBm or more		−1 dBm or more
Output level stability	Temperature stability	Within 0.2 dB (*3)		Within 0.3 dB (*4)
	Time stability	Within ±0.003 dB (*5) Within ±0.03 dB (*6)		Within ±0.005 dB (*5) Within ±0.05 dB (*7)
Optical connector		Universal connector		
Applicable fiber		SM (10/125)		

Common conditions:

CW light, 0.0 dB attenuation

At fiber emission end when a 2 m long SMF having FC-PC connector is connected.

(At the universal connector emission end for temperature stability)

(*1) 25±3°C

(*2) RMS × 2 (δ × 2 in RMS method)

(*3) 0 to 50°C, 8 hours

(*4) 0 to 40°C, 8 hours

(*5) Fixed temperature (at a point of 20 to 30°C), 5 minutes

(*6) ±1°C within 0 to 50°C, 1 hour

(*7) ±1°C within 0 to 40°C, 1 hour

Table 1-4 Specifications of Filtered LED Unit

Unit		AQ4218 (131)	AQ4218 (155)
Center wavelength (*1)		1310±10 nm	1550±10 nm
Spectrum half width (*1, *2)		20 nm or less	25 nm or less
Optical output level (*1)		–50 dBm or more	
Output level stability	Temperature stability	Within 0.2 dB (*3)	
	Time stability	Within ±0.003 dB (*4) Within ±0.03 dB (*5)	
Optical connector		Universal connector	
Applicable fiber		SM (10/125)	

Common conditions:

CW light, 0.0 dB attenuation

At fiber emission end when a 2 m long SMF having FC-PC connector is connected.

(At the universal connector emission end for temperature stability)

(*1) 25±3°C

(*2) RMS × 2 (δ × 2 in RMS method)

(*3) 0 to 50°C, 8 hours

(*4) Fixed temperature (at a point of 20 to 30°C), 5 minutes

(*5) ±1°C within 0 to 50°C, 1 hour

2. Before Starting System Operations

This chapter describes the unpacking and acceptance inspection rules and the general notes that you must follow before starting your system operations.

2.1 Unpacking and Acceptance Inspection

Your AQ2140 has been checked both mechanically and electrically at the factory, and its normal operations have been guaranteed. However, when you receive your system, immediately unpack and check it for any defect caused by the transportation.
We recommend to keep the insulator materials and fiberboard containers for future reuse (except for consumable materials).

2.2 Mechanical Operation Checkout

Check the system appearance, and switch and control operations for any damage due to transportation. Also, check the inventory of accessories and spare parts by referring to the packing list.

2.3 System Operation Test

When the system mechanical operations are normal, check the system performance by system operation test.

2.4 If any Defect or Trouble is found

If you have found any defect or trouble on your system, call the service immediately.

3. System Operation Notes

This chapter gives the basic system operation notes that you must follow when using your AQ2140.

3.1 Handling Notes

(1) The AQ2140 is a Safety Class-1 (IEC348) instrument.

(2) Avoid an excessive impact onto your optical multimeter. Although the display panel is covered with a plastic cover, the glass surface can be scratched or broken by the impact.

(3) Do not leave your optical multimeter in a high temperature or high humidity for a long period.

(4) Keep your optical multimeter away from the large magnetic fields or radiation source. The electromagnetic interference (EMI) can cause system malfunction.

(5) Do not connect your AQ2140 to an undefined instrument, or your optical multimeter will fail.

(6) Power OFF your AQ2140 before connecting or disconnecting it to/from another instrument. Otherwise, your AQ2140 and the mating instrument may fail.

(7) Keep the rear ventilation hole of your AQ2140 away from the wall and others. Poor ventilation causes an overheating that can damage your AQ2140 and other instruments.

(8) Do not turn the power supply OFF during data storage (see Section 5.4.4) and during key switch operations (see Table 4-1). If done, the parameter table (see Section 5.4.2) may be erased from memory.

(9) Your AQ2140 has a fuse against an overcurrent. If it blows, unplug the power cord, and replace the fuse at the AC voltage input socket (see Table 4-1).

(10) Your AQ2140 has a temperature fuse against an instrument overheating. If the power supply does not turn ON after recovery processing of paragraph (9) above, the temperature fuse may have been blown. Call the service.

(11) Do not remove covers of your AQ2140 except by the service personnel.

3.2 Application Notes on Optical System Components

Your AQ2140 has the very high precision optical system components. They are critical parts for assured system performance. Use the operation instructions and notes given by the respective instruction manuals.

4. System Functions

This chapter explains the basic system functions.

4.1 Operator Panel

Figure 4-1 shows the controls and indicators on the operator panel. The numbers of this figure correspond to the name and functions of the operator panel given on Table 4-1.

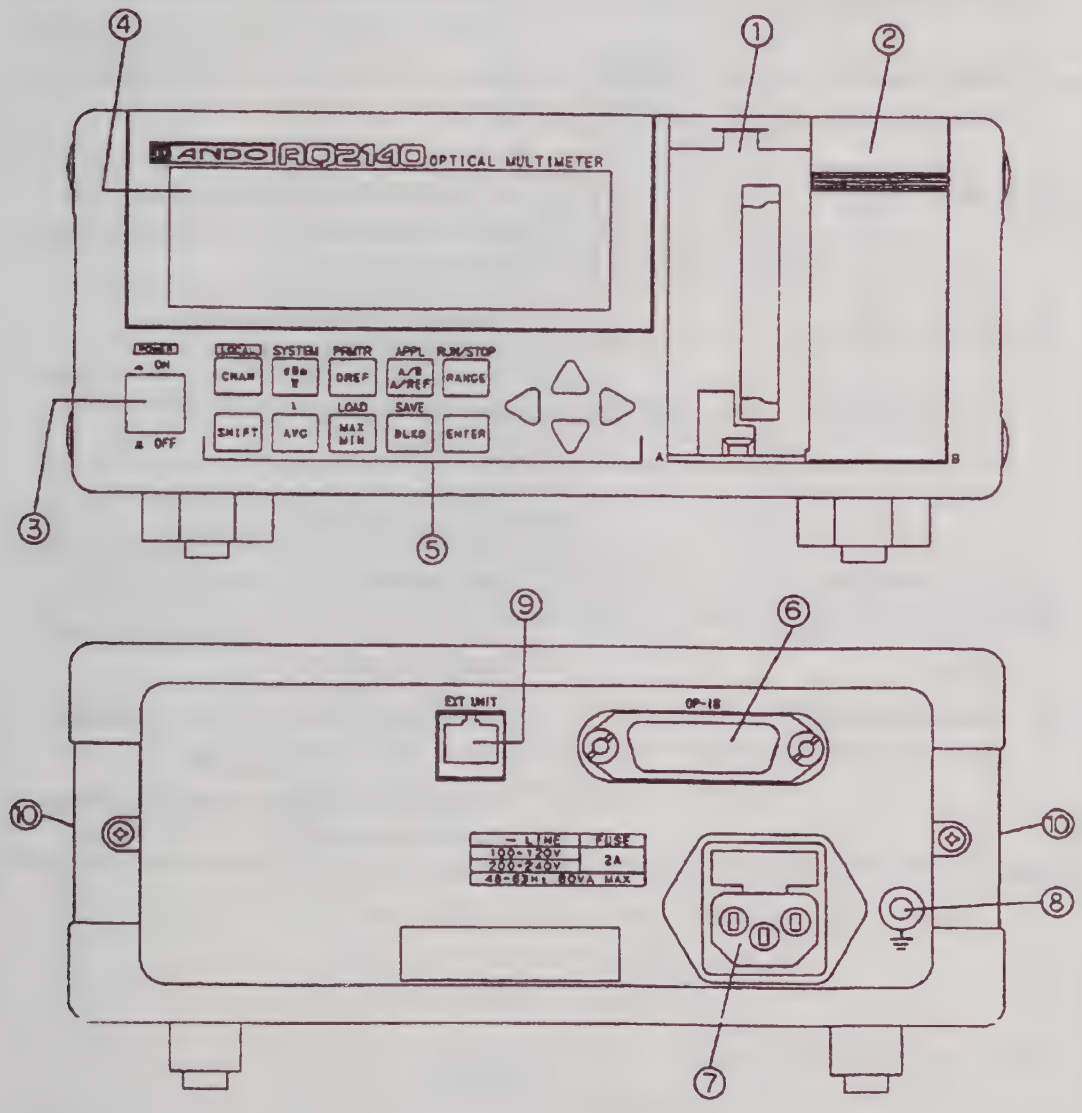

Figure 4-1 Operator Panel

Table 4-1 Name and Functions of Operator Panel

No.	Name	Unit Display	Functions
①	Unit storage	[A], [B]	Accommodates two different types of units. **CAUTION** **Turn the power switch OFF before inserting or removing the units into/from these storage slots.**
②	Blank panel		This is a dummy panel that is used when you do not insert any unit into the storage.
③	Power switch	[POWER] [▬ ON] [▮ OFF]	Turns the multimeter power supply ON or OFF.
④	Display panel		A fluorescent lamp display panel that shows the set values, measurement results and other information.
⑤	Key switches		Used for multimeter control. See Table 4-2 for details.
⑥	GPIB interface	[GP-IB]	A 24-pole signal connector for GPIB interfacing
⑦	AC power socket		Plug the power cord into this socket. The socket has a built-in fuse.
⑧	GND terminal	[⏚]	The ground (GND) terminal
⑨	External unit signal socket	[EXT UNIT]	Used for signal I/O to/from an external (peripheral) unit.
⑩	Ventilation hole		The ventilation hole for heat radiation. **CAUTION** **Keep this ventilation hole away from the wall and others.**

Table 4-2 Indication and Functions of Key Switches

Key name	Functions
SHIFT	Switches between the Measurement mode and Parameter Setup mode each time it is pressed as follows: Measurement mode → Parameter Setup mode → Measurement mode → ... During Measurement mode, the function shown on each key top is valid. During Parameter Setup mode, the function shown above each key (and the CHAN key top function) is valid.
[LOCAL] CHAN	Selects a channel to control. The channels are selected one after the other when this key is pressed. If no unit is connected, its channel is skipped. If you select the "A&B" channel, the unit connected to channel A is controlled (as channel A has the higher priority). Your subsequent key operations are valid for the selected channel only. The GPIB interface is switched to the Local mode if it is in the Remote mode. No units can operate during Local Lockout.
	Measurement mode: A → B → A&B → A → ...
	Parameter Setup mode: A → B → EX1 → ... → A → ...
[SYSTEM] dBm W	Measurement mode (valid for the sensor unit only): Selects a measurement unit (dBm or W) each time it is pressed. dBm → W → dBm → ... When it is pressed during relative measurement or during MAX/MIN measurement, the unit setup is released and the absolute value measurement is selected.
	Parameter Setup mode: Used for system parameter setup (see Section 5.4.1). The cursor shifts in the following sequence when the key is pressed: ADRS → TONE → VOLUME → BRIGHT → INT → ADRS → ... Modify the parameter values using the [MODIFY] key, and press the ENTER key for setup.

Key name	Functions
[PRMTR] DREF	Measurement mode (valid for the sensor unit only): Starts the Display Reference measurement that shows the subsequent measurement data that is relative to the reference data you have selected. To release the Display Reference measurement, press the dBm W and A/B A/REF keys simultaneously. If you select the unit of "W" and start this measurement, the relative value is shown as the ratio and no unit is shown.
	Parameter Setup mode: Selects a unit parameter (see Section 5.4.2). The cursor shifts in the following sequence when the key is pressed. Sensor unit: CALF → REF → CHOP → AVG → CALF → ... Optical source unit: CHOP → ATT → CHOP → ... Modify the parameter values using the [MODIFY] key, and press the ENTER key for setup.
[APPL] A/B A/REF	Measurement mode (valid for the sensor unit only): Selects the Channel-to-Channel Comparison Measurement (A/B or B/A channel comparison) or the Reference Measurement based on the reference values (A/REF or B/REF). To release these modes, press the dBm W and DREF keys simultaneously. The measurement modes are switched as follows each time this key is pressed: Channel Comparison measurement → Reference measurement → Channel Comparison measurement → ... No channel comparison measurement starts if there is only a single sensor unit. If you select the unit of "W" and start this measurement, the relative value is shown as the ratio and no unit is shown.
	Parameter Setup mode (valid for the sensor unit only): Selects an application (see Section 5.4.4). The parameters are selected in the following sequence when the key is pressed: STOR → GRPH → ALIGN → STOR → ...

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Key name	Functions
[RUN/STOP] RANGE	Measurement mode (valid for the sensor unit only): Turns the fixed measurement range ON or OFF. During fixed measurement range, you can increase or decrease the measurement range using the ◄ and ► MODIFY keys.
	Parameter Setup mode: Starts or stops the application execution.
[λ] AVG	Measurement mode (valid for the sensor unit only): Turns the averaging processing ON or OFF.
	Parameter Setup mode (valid for the sensor unit only): Selects a calibration wavelength. The wavelength is changed in the following sequence each time the key is pressed. The values outside of the wavelength operating range of sensor are skipped. 850 → 1300 → 1310 → 1550 → 850 → ... During this mode, you can modify the wavelength at every 1-nm step using the [MODIFY] key. Press the ENTER key for its setup. You can set the calibration wavelength within the wavelength operating range of each sensor.
[LOAD] MAX MIN	Measurement mode (valid for the sensor unit only): Displays the maximum value, minimum value, and difference from the point where you have pressed the key. The values are updated each time this key is pressed. To release it, press the dBm W , DREF , and A/B A/REF keys.
	Parameter Setup mode: Recalls the parameter table (see Section 5.4.2). During this mode, select a table to recall using the [MODIFY] key and press the ENTER key for setup.

Key name	Functions
[SAVE] BLKG	Measurement mode (valid for the sensor unit only): Sets the display resolution of measurement. Undisplayed digits are truncated. It is changed as follows each time the key is pressed: Full-digit display → No display of lowest-order digit → No display of low-order 2 digits → Full-digit display → ...
	Parameter Setup mode: Stores the parameter table (see Section 5.4.2) in memory. During this mode, select the table to store using the [MODIFY] key and press the ENTER key for setup.
ENTER	Enters your modification in the Parameter Setup mode. If you press any other key before the ENTER key, the value is not updated. This key is invalid during Measurement mode.
(MODIFY) ▲ ▼	Measurement mode (valid for the sensor unit only): Increases or decreases the range during fixed measurement range. This key is invalid during variable measurement range.
	Parameter Setup mode: Increases or decreases a numeric value.
(MODIFY) ◄ ►	Measurement mode: Switches the auxiliary display parameters. Use the ► key to switch the parameters in the following sequence. Use the ◄ key to switch them in the reverse procedure. Sensor unit: λ → CALF → REF → MAX → MIN → DIFF → CHOP → AVG → RANGE → λ → ... If the maximum and minimum value displays are OFF, the MAX, MIN and DIFF displays are skipped. If the measurement range is not fixed, the RANGE display is skipped.
	Optical source unit: TYPE → λ1 → λ2 → ATT → CHOP → TYPE → ... If a single optical source is used, the λ2 parameter is skipped.
	Parameter Setup mode: Changes the numerical digits.

NOTE: If an optical source unit is connected to channel A, the sensor unit is connected to channel B, and the "A&B" channel is selected to control, the optical source unit is controlled (as channel A has the higher priority). The keys only valid for the sensor unit (such as [dBm W] key) are all invalid.

4.2 Explanation of Display Panel

Figure 4-2 shows the display panel (when all lamps light by the lamp test during power ON). Table 4-3 explains each display.

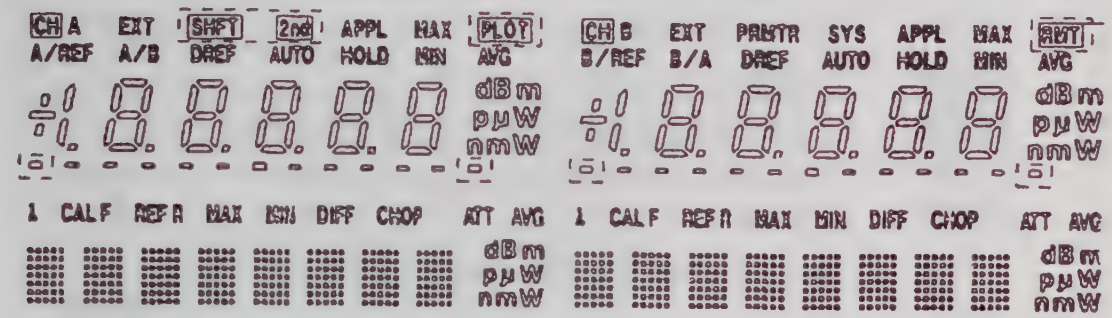


Figure 4-2 Indication of Display Panel

NOTE: If you continue the high intensity (by setting the "BRIGHT" system parameter to "4") for a long time, the intensity of fluorescent lamps may drop. To have a clear display and the long service life, reduce the display intensity.

Table 4-3 Explanation of Display Panel (1/2)

Indication	Explanation	Related Keys
7-segment display	Displays the measured value.	
CH A, CH B	The control channel lights.	CHAN
EXT	Lights when an external unit is connected to the channel and controlled.	CHAN
SHFT	Lights when the Parameter Setup mode is selected.	SHIFT
SYS	Lights during system parameter setup.	SYS
PRMTR	Lights during unit parameter setup.	PRMTR
APPL	Lights during application execution.	APPL
PLOT	Lights during output to the plotter.	
RMT	Lights during Remote control via GPIB interface.	
A/REF B/REF	Lights during relative measurement based on the reference set value.	A/B A/REF
A/B B/A	Lights during channel-to-channel comparison.	A/B A/REF
DREF	Lights during relative measurement based on the reference display value.	DREF
AUTO	Lights during automatic range switching mode.	RANGE
HOLD	Lights during manual range switching mode.	RANGE
MAX MIN	Lights during maximum and minimum value measurement.	MAX MIN
AVG	Lights during averaging measurement.	AVG

Table 4-3 Explanation of Display Panel (2/2)

Indication	Explanation
5 × 7-dot display	Displays the measuring conditions you have set.
λ	Lights during calibration wavelength display.
CALF	Lights during calibration coefficient display.
REF	Lights during reference value display.
MAX	Lights during maximum value display.
MIN	Lights during minimum value display.
DIFF	Lights during differential value display.
CHOP	Lights during CHOP frequency display.
ATT	Lights during optical attenuation display.
AVG	Lights during averaging count display.

4.3 Mounting/Dismounting the Blank Panel

Your AQ2140 has a single blank panel in the accessory kit.

If you do not insert a unit into the storage slot, always mount the blank panel for storage protection. Figure 4-3 illustrates how to mount the blank panel, and Figure 4-4 illustrates how to remove it.

CAUTION

Your AQ2140 can be damaged by a conductive metal chip if it enters in the unit storage.

4.3.1 Mounting the blank panel

Allign protruding portion on the blank panel to the groove on the unit storage (1) and push it into the device as shown in Figure 4-3.

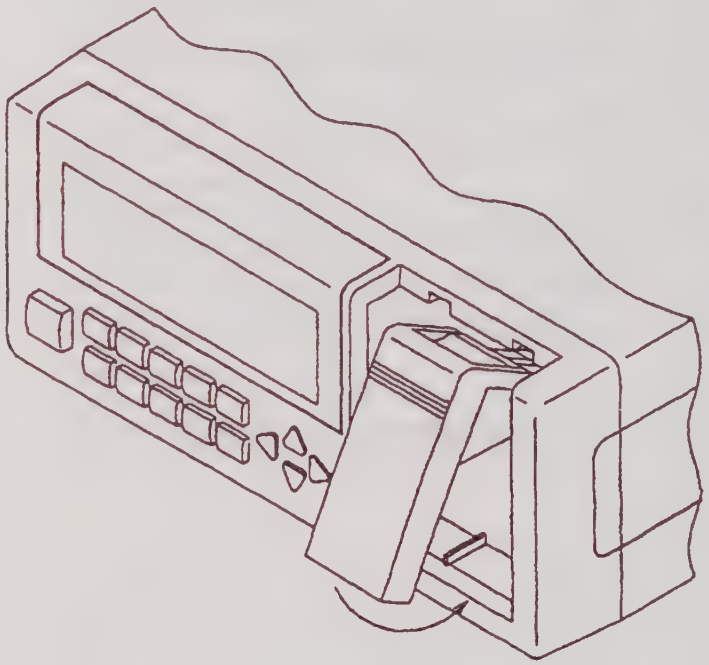


Figure 4-3 Mounting the Blank Panel

4.3.2 Removing the blank panel

Pull the blank panel forward while pushing the knob on top of the panel.

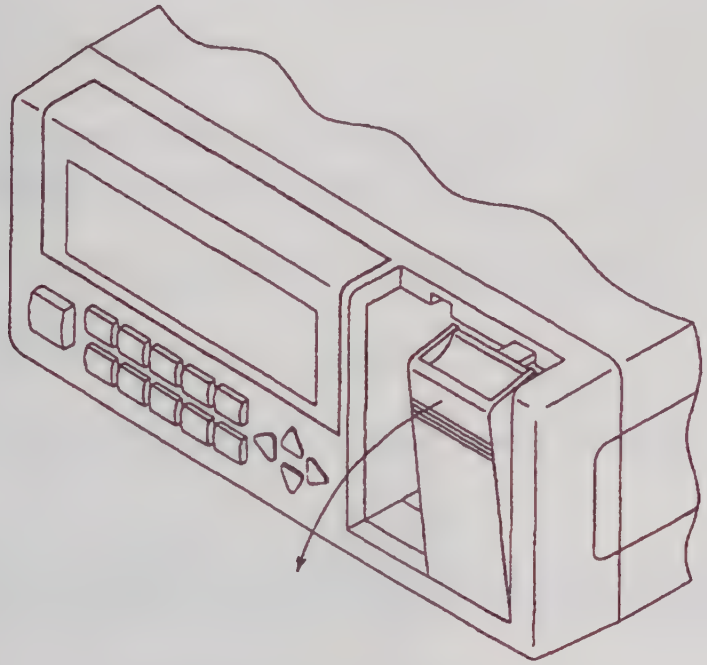


Figure 4-4 Removing the Blank Panel

5. System Operations

This chapter explains how to use your AQ2140.

5.1 Before Turning ON

(1) Make sure that the AQ2140 has been turned OFF ([POWER]) switch ③ must be [■ OFF].

(2) Check the correct fuse capacity at the AC voltage fuse socket.

(3) Check the source voltage of your AQ2140.

(4) Insert the desired Unit into slot ① of the unit storage of AQ2140.

CAUTION

Turn the multimeter power switch OFF ([■ OFF]) before mounting or dismounting the Unit to/from the Unit storage. Otherwise, the Unit will be damaged.

CAUTION

Do not connect an instrument or Unit that is NOT approved by Ando Electric to your AQ2140 Optical Multimeter. If done, both the connected instrument/Unit and AQ2140 may be damaged.

(5) Plug the power cord of your AQ2140 into the wall receptacle. If you have a two-pole socket, use the power adapter of accessory kit and ground the lead correctly.

(6) Make sure that the ambient conditions satisfy the requirements (see the system specifications). Keep your AQ2140 away from excessive dust.

(7) Place your AQ2140 on a stable and horizontal workbench. Take care not to restrict the air flow at the rear ventilation hole of AQ2140.

(8) Make sure that all units are securely connected to your AQ2140.

5.2 Operation Checkout

This section explains the power-on sequence and initial system operations.

(1) Checkout of display panel, memory test, and connected Units
Connect the Unit(s) you wish to use, and turn the power switch ON ([▬ ON]). The 5 × 7-dot display will light one after the other, and all lamps will light (see Section 4.2) for checkout of display panel, memory test, and connected Units. If they do not light, the display panel has failed. If the memory or connected Unit has failed, an error message (see Section 5.6) appears.

(2) Initial operations
Figures 5-1 (a) to 5-1 (c) show the initial screen of your AQ2140 after the unit checkout. Numerical values of these figures are only reference.

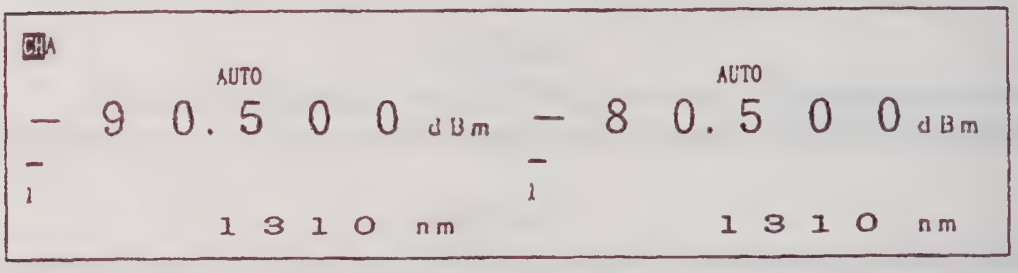


Figure 5-1 (a) Initial Screen 1 (Sensor for Channel A, and Sensor for Channel B)

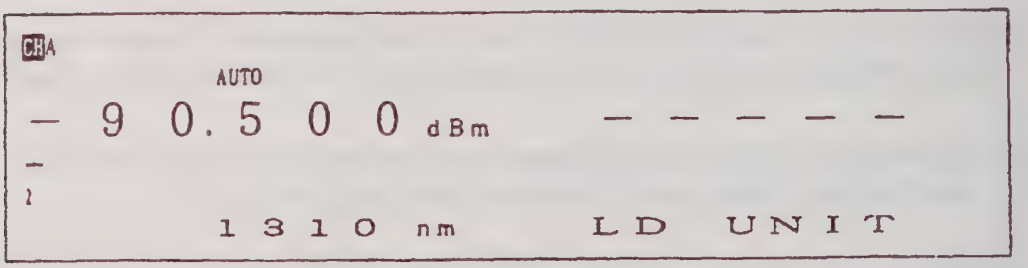


Figure 5-1 (b) Initial Screen 2
(Sensor for Channel A, and Light Source for Channel B)

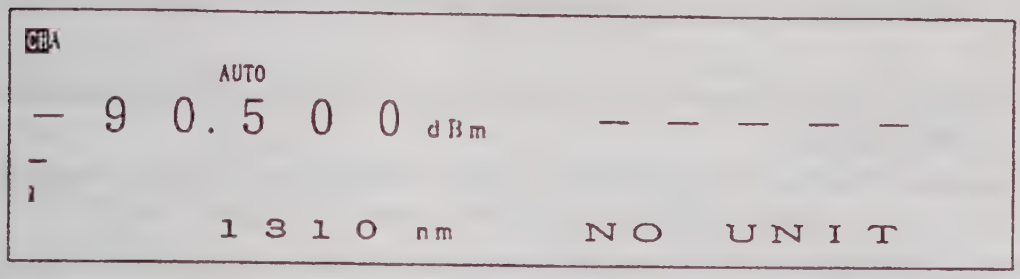


Figure 5-1 (c) Initial Screen 3 (Sensor for Channel A, but no unit for Channel B)

(3) To allow highly reliable and wide dynamic range measurement, wait approximately one hour (heat-up) after power ON.

(4) Before using the Sensor Unit, shield the photosensor from the ambient light and zero-adjust it (by Zero Set functions).

(5) Turn the power switch OFF when you do not use.
When you do not use your AQ2140, turn the power switch OFF. Wait at least five seconds before the next power ON.

(6) How to initialize the set values?
To initialize all parameters to their initial status, hold down the [SHIFT] key and turn the power switch ON.

DANGER

If an overheat or an electrical shock is found during measurement, turn the power switch OFF immediately ([■ OFF]) and call the service.

NOTE: The AQ2140 does not satisfy the specification during the application of noise in some cases.

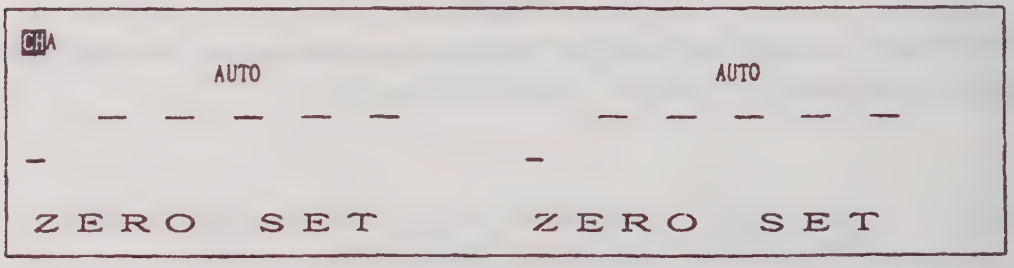
5.3 Operations during Measurement Mode

This section explains the operations and display of the AQ2140 in the Measurement Mode using typical examples.
Unless otherwise noted, you must use the operations and display on the initial screen (see Section 5-2). It is assumed that Sensor Units are connected to channels A and B.
During Measurement mode, you can modify the 5 × 7-dot display using the [◄] and [►] MODIFY keys.

5.3.1 Zero-adjustment (by Zero Set functions)

Operation key (Unit)	[ZERO]

Each unit has the zero-adjustment (Zero Set) key, but the AQ2140 Optical Multimeter does not have such key.
To zero-adjust the unit, press the [ZERO] key on it.
The zero-adjustment usually takes 20 to 30 seconds.
If you press the [ZERO] key during zero-adjustment, the adjustment is canceled and the AQ2140 returns to the normal measurement mode.
When you press the [ZERO] key on both the Sensor Units connected to channels A and B, the AQ2140 shows the "ZERO SET" screen of Figure 5-2.



<Letters ZERO SET flash.>

Figure 5-2 ZERO SET Screen

Before starting zero-adjustment, shield the photosensor from the ambient light. The poor shielding causes an error (see Section 5.6). In such case, the zero-adjustment fails and the AQ2140 returns to the normal display.

5.3.2 Switching of optical modulation modes

Operation key (Unit)	CW CHOP

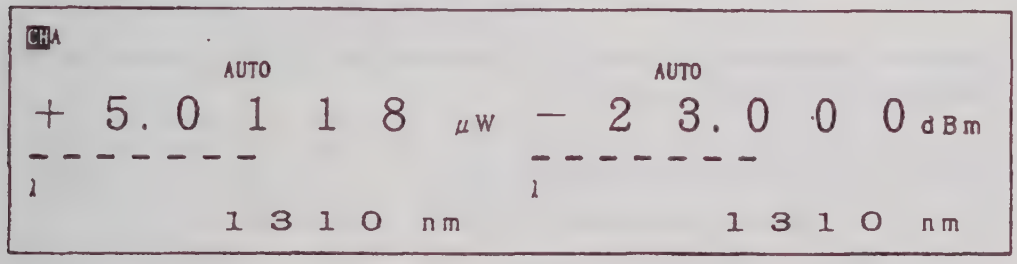
Each unit has the optical modulation mode selector key, but the AQ2140 does not have such key.
To switch the optical modulation mode, press the CW CHOP key on the unit.
When you select the CW optical modulation mode, its front panel LED goes out. When you select the CHOP modulation mode, its LED lights.

5.3.3 Absolute value measurement

Operation key [SYSTEM]	dBm W

The AQ2140 shows the absolute value measurement in dBm on the initial screen.
To select the "W" unit absolute measurement, press the dBm W key.
To return to the "dBm" unit absolute measurement, just press the dBm W key again.

If you press the dBm W key when controlling the Unit of channel A, the AQ2140 shows the screen of Figure 5-3. The 5 × 7-dot display shows the calibrated wavelength.



<When –23 dBm signals are entered in both channels>

Figure 5-3 Absolute Value Measurement Screen

5.3.4 Relative value measurement

Operation key	[PRMTR]	[APPL]
	DREF	A/B A/REF

Release key	[SYSTEM]	[PRMTR]	[APPL]
	dBm W	DREF	A/B A/REF

The AQ2140 supports three types of relative value measurement.

(1) Display Reference measurement: Allows relative measurement based on the measured values as reference data.

(2) Channel-to-Channel Comparison: Allows comparison measurement with another channel.

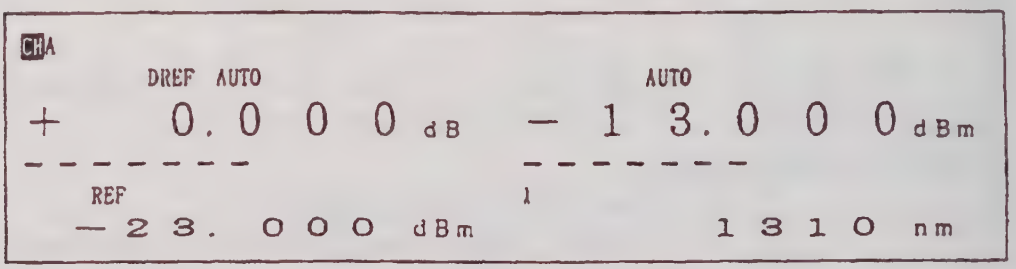
(3) Reference measurement: Allows relative measurement based on the set values as reference data. (For entry of set values, see Section 5.4.2.)

If you press the DREF key when controlling the Unit of channel A, the AQ2140 shows the screen of Figure 5-4 (a).

The reference value is updated each time the DREF key is pressed.

To release it, press the dBm W or A/B A/REF key. The respective measurement mode will be selected.

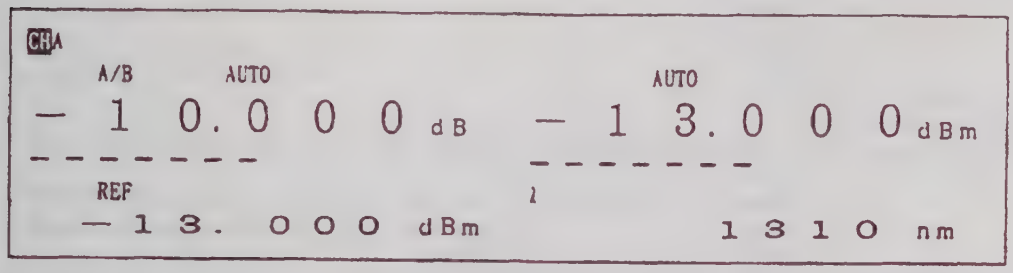
The "REF" value of 5 × 7-dot display shows the measured value when this key is pressed.



<When –23 dBm signals are entered in channel A and when –13 dBm signals are entered in channel B>

Figure 5-4 (a) Display Reference Measurement Screen

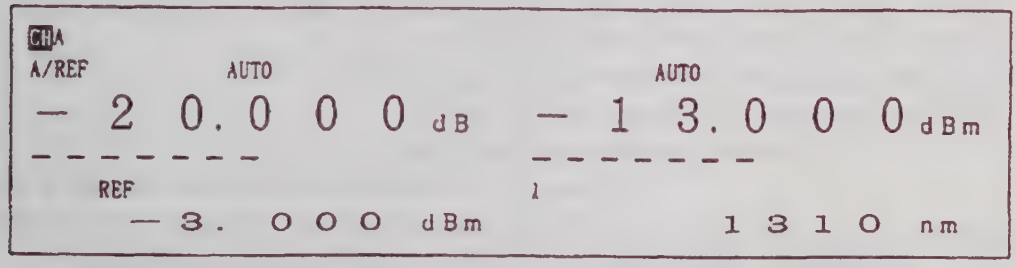
If you press the A/B A/REF key when controlling the Unit of channel A, the AQ2140 shows the screen of Figure 5-4 (b).
The "REF" value of 5 × 7-dot display shows the measured value of channel B.



<When –23 dBm signals are entered in channel A and when –13 dBm signals are entered in channel B>

Figure 5-4 (b) Channel Comparison Measurement Screen

If you press the A/B A/REF key on the screen of Figure 5-4 (b), the AQ2140 shows the screen of Figure 5-4 (c).
You can return to the screen of Figure 5-4 (b) by pressing the A/B A/REF key again.
To release it, press the dBm W or DREF key. The respective measurement mode will be selected.
The "REF" value of 5 × 7-dot display shows your set values (see Section 5.4.2).



<When -3 dBm is set on channel A.>
<When –23 dBm signals are entered in channel A and when –13 dBm signals are entered in channel B>

Figure 5-4 (c) Reference Measurement Screen

5.3.5 Maximum and minimum value measurement

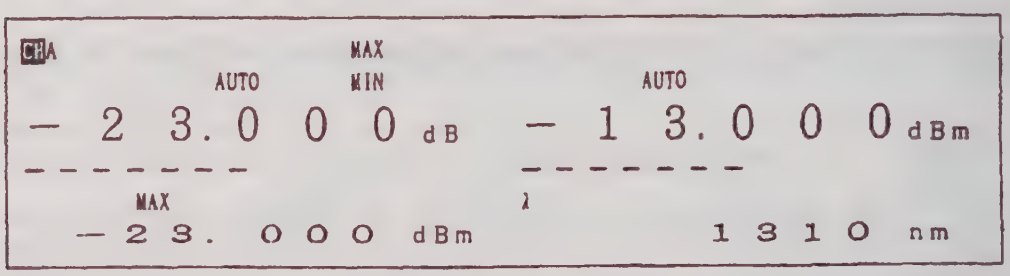
Operation key	[LOAD]
	MAX MIN

Release key	[SYSTEM]	[PRMTR]	[APPL]
	dBm W	DREF	A/B A/REF

During maximum and minimum value measurement, the 5 × 7-dot display shows the maximum value, minimum value, and differential value of the 7-segment display. The information of the 7-segment display remains unchanged.

If you press the [MAX MIN] key when controlling the Unit of channel A, the AQ2140 shows the screen of Figure 5-5.

The maximum and minimum values are reset each time the [MAX MIN] key is pressed.



<When –23 dBm signals are entered in channel A and when –13 dBm signals are entered in channel B>

Figure 5-5 Maximum and Minimum Value Measurement Screen

You can modify the MAX, MIN and DIFF values of the 5 × 7-dot display using the [◄] and [►] MODIFY keys. To return to the MAX value display mode, press the [MAX MIN] key.

5.3.6 Averaging measurement

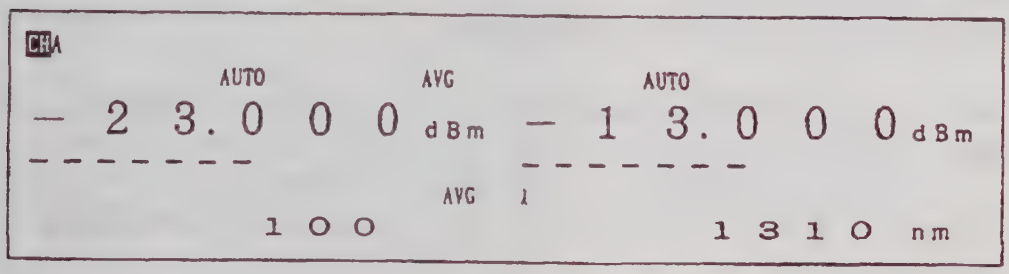
Operation key	[λ]
	AVG

The AQ2140 uses the sequential addition averaging method. (*1)

To start averaging measurement, press the [AVG] key.
To release it, just press the [AVG] key again.

If you press the [AVG] key when controlling the Unit of channel A, the AQ2140 shows the screen of Figure 5-6. If the averaging count (see Section 5.4.2) is less than your set count, the 7-segment display flashes.

The 5 × 7-dot display shows the averaging count you have set.



<If 100 averaging times are set for channel A>
<When –23 dBm signals are entered in channel A and when –13 dBm signals are entered in channel B>

Figure 5-6 Averaging Measurement Screen

*1 The measured values are sequentially added, and the result is averaged at the certain measurement interval (see Section 5.4.1). If the averaging count is less than the set count, the measured values up to this point are averaged and displayed.

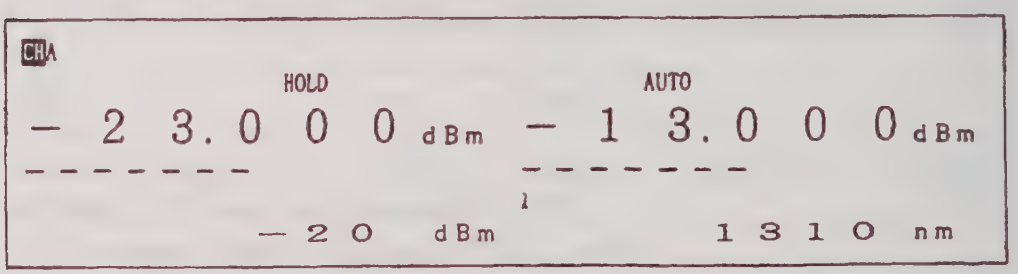
5.3.7 Changing the measurement range

Operation key	[RUN/STOP]
	RANGE ▲ ▼

The AQ2140 automatically selects a measurement range based on the incident light.
To manually change the measurement range, press the RANGE key to fix the measurement range.
Then, increase or decrease the range using the ▲ and ▼ MODIFY keys.

If you press the RANGE key when controlling the Unit of channel A, the AQ2140 shows the screen of Figure 5-7.

Press the RANGE key again to return to the automatic range selection mode.
The 5 × 7-dot display shows the measurement range.



<When –23 dBm signals are entered in channel A and when –13 dBm signals are entered in channel B>

Figure 5-7 Changing the Measurement Range

If an incident light is out of measurement range during fixed measurement range, the upper limit or lower limit value flashes on the 7-segment display. During automatic measurement range selection, the same result occurs if the incident light is outside of the power range that is set for each sensor unit.

5.4 Operations during Parameter Setup Mode

This section explains the operations and display of the AQ2140 in the Parameter Setup mode using typical examples.

Unless otherwise noted, you must use the operations and display on the initial screen (see Section 5-2). This section also gives some examples where the Sensor Unit is connected to channel A and the Light Source Unit is connected to channel B.

During Parameter Setup mode, you can shift the parameter values flashing on the 5 × 7-dot display using [◄] and [►] MODIFY keys.
Also, you can modify these values using the [▲] and [▼] MODIFY keys.
To enter your modification, press the [ENTER] key.

To return all parameters to their initial setup, hold down the [SHIFT] key and turn the power switch ON.

NOTE: The parameter values you have modified using the MODIFY keys are set only when you press the [ENTER] key. If you do not press the [ENTER] key and select another measurement mode or parameter setup mode, all of your modification data is lost.

5.4.1 System parameter setup

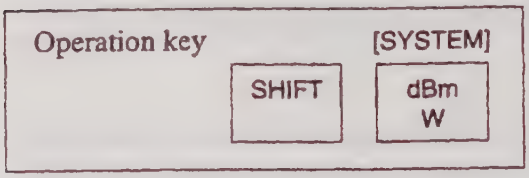


Table 5-1 lists the system parameters that you can set from your AQ2140.

Table 5-1 System Parameters

On-screen display	Parameter	Setup Range	Initial Setup
ADRS	GPIB address	0 to 30	19
TONE	Beep tone	16 tones (1 to 16)	8
VOLUME	Beep volume	5 volume levels (0 to 4)	4
BRIGHT	Display brightness	4 brightness levels (1 to 4)	3
INT	Measurement interval	10 (20), 50, or 100 msec	100 msec

The measurement interval is set to 10 msec minimum if a single Sensor Unit is connected. It is set to 20 msec minimum if two Sensor Units are connected.

If you press the [SHIFT] and [SYSTEM] keys simultaneously when controlling the Unit of channel A, the AQ2140 shows the screen of Figure 5-8.

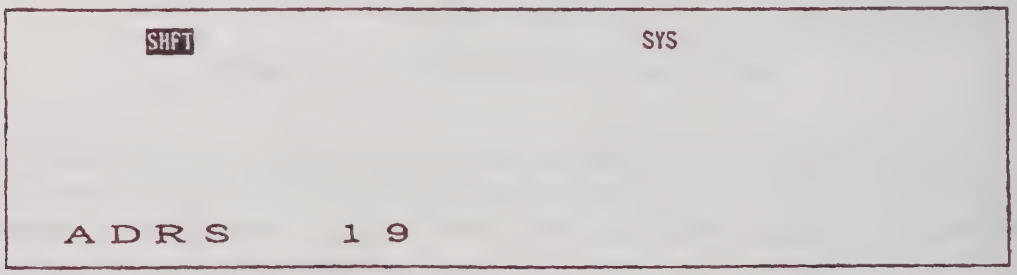


Figure 5-8 System Parameter Setup Screen

You can select a system parameter by pressing the [SYSTEM] key on the screen of Figure 5-8.

Select a parameter you wish to modify, enter the desired value using the MODIFY key, and press the [ENTER] key for setup.

5.4.2 Unit parameter setup

Operation key	[PRMTR]	[LOAD]	[SAVE]
SHIFT	DREF	MAX MIN	BLKG

(1) Sensor unit parameters

Table 5-2 lists the Sensor Unit parameters.

Table 5-2 Sensor Unit Parameters

On-screen display	Parameter	Setup Range	Initial Setup
CAL F	Calibration value	±199.999 dB	0 dB
REF	Reference value	±199.999 dBm	0 dBm
CHOP f	CHOP frequency	270 Hz, 1 kHz, or 2 kHz	270 Hz
AVG	Averaging count	2, 5, 10, 20, 50, 100, or 200 times	10

If the unit is in CW mode, it continues even when you modify the CHOP frequency in this mode.
To modify the unit operation, use the CW CHOP key on that unit.

If you press the SHIFT and [PRMTR] keys simultaneously when controlling the Unit of channel A, the AQ2140 shows the screen of Figure 5-9.

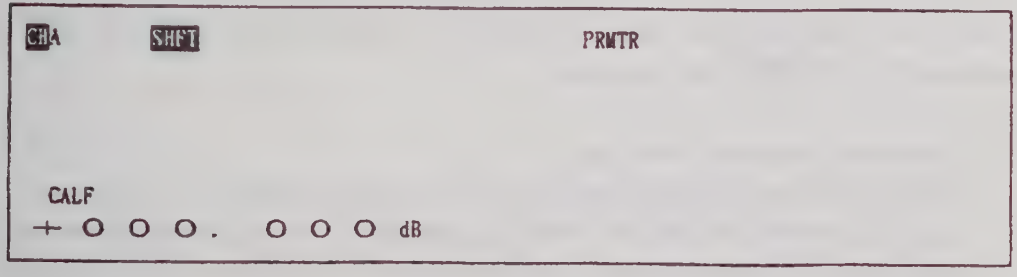


Figure 5-9 Sensor Parameter Setup Screen

You can select a sensor parameter by pressing the [PRMTR] key on the screen of Figure 5-9. Select a parameter you wish to modify, enter the desired value using the MODIFY key, and press the ENTER key for setup.

(2) Parameters of Light Source Unit

Table 5-3 lists the parameters of the Light Source Unit.

Table 5-3 Parameters of Light Source Unit

On-screen display	Parameter	Setup Range	Initial Setup
ATT	Optical attenuation	6.0 dB (at 0.1-dB step)	0 dB
CHOP f	CHOP frequency	270 Hz, 1 kHz, or 2 kHz	270 Hz

If the unit is in CW mode, it continues even when you modify the CHOP frequency in this mode.

To modify the unit operation, use the CW CHOP key on that unit.

If you press the SHIFT and [PRMTR] keys simultaneously when controlling the Unit of channel A, the AQ2140 shows the screen of Figure 5-10.

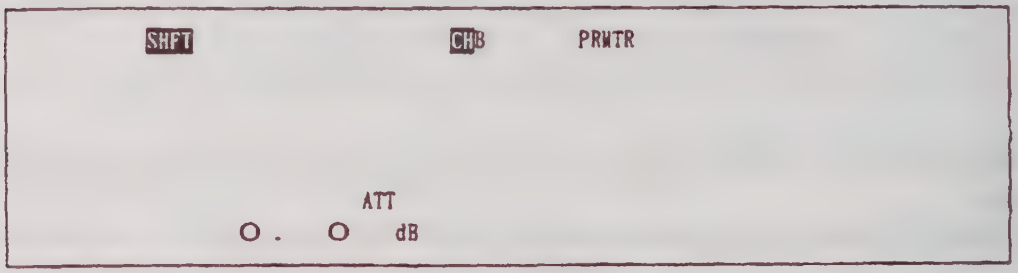


Figure 5-10 Parameter Setup Screen of Light Source Unit

You can select a parameter by pressing the [PRMTR] key on the screen of Figure 5-10. Select a parameter you wish to modify, display the desired value using the MODIFY key, and press the ENTER key for setup.

(3) Parameter storage and recalling

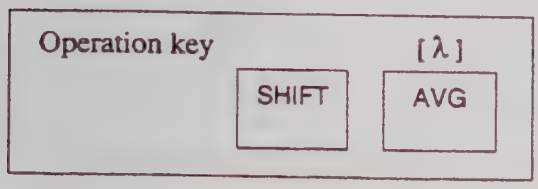
The AQ2140 has 10 parameter tables (0 to 9) for each channel. The Sensor parameter tables are listed on Table 5-2, and Light Source parameter tables are listed on Table 5-3. Parameter table 0 has been set to the initial setup, and you can use parameter tables 1 to 9.

To store a parameter table, enter the desired unit parameters and press the [SAVE] key. Then, display the storage table number using the [MODIFY] key, and press the ENTER key for setup.

To recall the parameter table, press the [LOAD] key, display the desired table number using the [MODIFY] key, and press the ENTER key.

5.4.3 Calibration wavelength setup

The calibration wavelength is a parameter unique to the Sensor Unit.



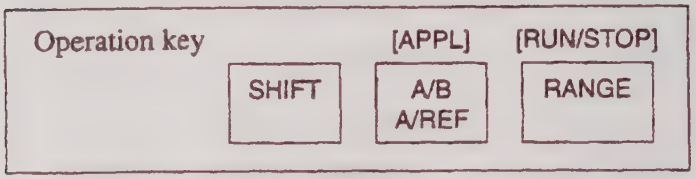
If you press the SHIFT and [λ] keys simultaneously when controlling the Unit of channel A, the AQ2140 shows the screen of Figure 5-11.

Figure 5-11 Calibration Wavelength Setup Screen

You can change the typical wavelength by pressing the [λ] key on the screen of Figure 5-11. To set a smaller wavelength, display the desired one using the [MODIFY] key and press the ENTER key. The wavelength operating range that can be set varies depending on each unit.

5.4.4 Application startup

The application is valid when the Sensor Unit is controlled by the control channel.



The AQ2140 can execute the following three types of application:

- Data storage (STOR)
- Plotting (GRPH)
- Alignment (ALIGN)

If you press the SHIFT and [APPL] keys simultaneously when controlling the Unit of channel A, the AQ2140 shows the screen of Figure 5-12.

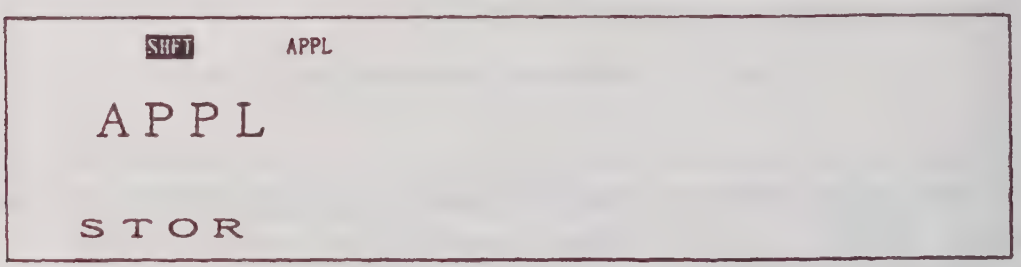


Figure 5-12 Application Selection Screen

You can change the application to execute by pressing the [APPL] key on the screen of Figure 5-12.
To start the application, display it and press the ENTER key.

(1) Data storage (STOR)

This application stores the measured data in memory of the AQ2140.
Up to 1000 data sets can be stored in memory. You can generate a graph of the measured data and output it by combination of plotting application (explained later).

Select "STOR" on the application selection screen (see Section 5.4.4) and press the ENTER key. The channel select screen will appear. You can select channel A or B (you cannot select both channels simultaneously). Select a channel for data storage, and the title input screen of Figure 5–13 will appear.

Figure 5–13 Title Input Screen (1)

Enter a data title in the 5 × 7-dot display area at the right of screen of Figure 5–13.
Display the desired letters using the [MODIFY] key, select all letters, and press the ENTER key. The title name is initially set to "AAAAAAAA".

After title data input, the measurement time input screen of Figure 5-14 appears.

Figure 5-14 Measurement Time Input Screen

On the screen of Figure 5-14, enter the measurement time in the right 5 × 7-dot display area.
Display the desired measurement time using the [MODIFY] key, and press the ENTER key for setup.
The measurement time is initially set to the measurement interval (see Section 5.4.1) multiplied by 1000.

Example: If the measurement interval is 100 msec:
100 msec × 1000 = 100 sec
= Display of "00:01:40"

After you have entered the measurement time, the AQ2140 enters the idle status. Press the [RUN/STOP] key to start measurement.

If a plotter is connected to your multimeter, it starts plotting the data automatically after the end of this application. The "Auto Scale" plotter output format is used (see Table 5-4).

Figure 5-15 gives a plotter output example.

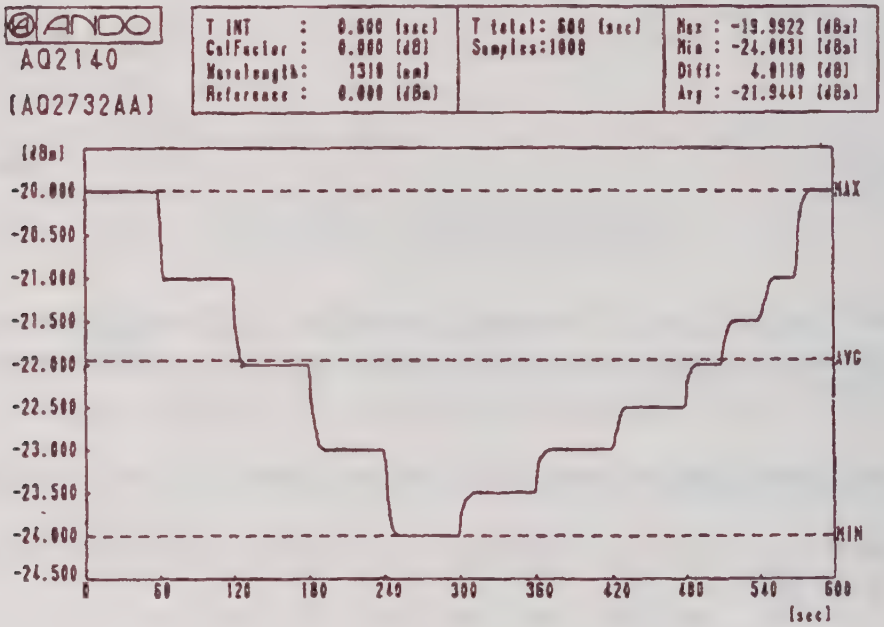


Figure 5-15 Plotter Output Example (in Auto Scale Mode)

After data plotting, the AQ2140 returns to the normal measurement mode.

To cancel the currently running application, press the SHIFT key.
The initial application selection screen (see Figure 5-12) will reappear.

If no plotter is connected to your AQ2140, the "PLOT ERR" error message is displayed. In such case, press the [RUN/STOP] key to retry plotting (by typing "Y" key) or return to the measurement mode (by typing "N" key).

(2) Plotting (GRPH)

This application generates a graph of memory data in any format and outputs it to a plotter.

On the application selection screen (see Figure 5-12), display "GRPH" and press the ENTER key. The title input screen of Figure 5-15 will appear.

Figure 5-16 Title Input Screen (2)

Enter a data title in the 5 × 7-dot display area at the right of screen of Figure 5-15. Display the desired letters using the [MODIFY] key, select all letters, and press the ENTER key. The title name has been set to the title name used during data storage.

After title data input, the plotting format setup screen appears. When you select the Auto Scale, the X- and Y-axis scales are set automatically. To manually set these axis scales, do not select the Auto Scale mode.

To manually set the output format, set the parameters of Table 5-4.

Table 5-4 Plotting Format Parameters

On-screen display	Parameter	Setup Range	Initial Setup
X MIN	Minimum value of axis X	0 to T_TOTAL	0 sec
X MAX	Maximum value of axis X	X_MIN to T_TOTAL	T_TOTAL
Y DIV	Y-axis scale interval	0.002, 0.005, 0.010, 0.020, 0.050, 0.100, 0.200, 0.500, 1.000, 2.000, 5.000, 10.000	1.000
	Y-axis unit	dB, mW, µW, nW, pW	dB

After you have completed the plotting format setup, the AQ2140 enters the standby mode. Press the [RUN/STOP] key to start plotting. Once plotting has started, the AQ2140 rejects any of control operations you specify.

Figure 5-17 gives an output example when you manually set the output format. This example uses the same data of Figure 5-15. However, only part of total measurement time is sampled, the data count ("Samples"), maximum value ("Max"), minimum value ("Min"), difference ("Diff"), and average ("Avg") differ from those of Figure 5-15.

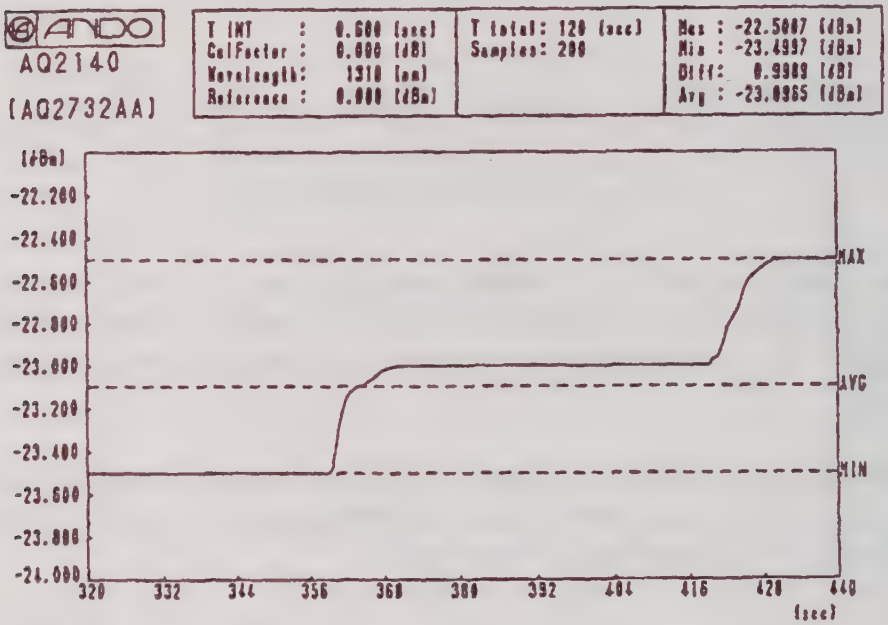


Figure 5-17 Plotter Output Example (in Manual Scale Mode)

After the plotting has completed, the AQ2140 returns to the normal measurement mode.

To cancel the currently running application, press the SHIFT key. The initial application selection screen (see Figure 5-12) will reappear.

If no plotter is connected to your AQ2140, the "PLOT ERR" error message is displayed. In such case, press the [RUN/STOP] key to return to the measurement mode.

NOTE: Your AQ2140 can directly plot data on the Graphtec's GD9411F or GD9411 plotter (via the GPIB interface).

NOTE: When using the plotter, set the DIP switches at the plotter rear panel to the "LITEN ONLY" mode. For other setup, refer to the plotter operation manual.

(3) Alignment (ALIGN)

This application uses the 5 × 7-dot display as a bar graph and shows the measured data variation in real-time mode. The control channel of the measurement mode has the higher priority. During two-channel control, channel A has the higher priority. (You cannot run the application on the two channels simultaneously.)

On the application selection screen (see Figure 5-12), display "ALIGN" and press the [ENTER] key. The upper limit input screen of Figure 5-18 will appear.

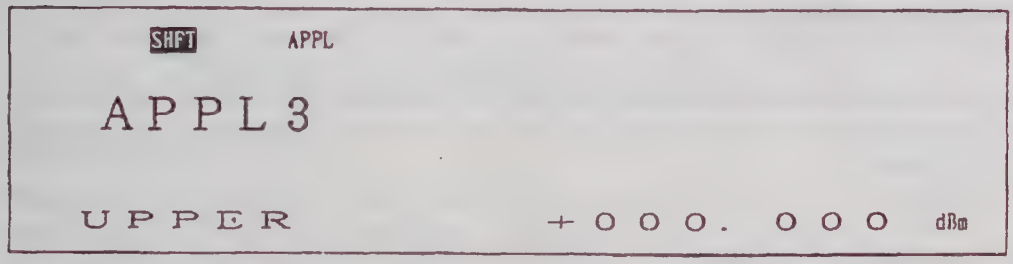


Figure 5-18 Upper Limit Input Screen

Set the upper limit in the 5 × 7-dot display area at the right of screen of Figure 5-16. Display the desired value using the [MODIFY] key, and press the [ENTER] key. The upper limit is initially set to "000.000 dBm".

After the upper limit input, you can enter the lower limit. Enter it in the similar way as for the upper limit input. You can enter the lower limit that is equal to the upper limit subtracted by 1 dB or more. The lower limit is initially set to the upper limit subtracted by 3.000 dBm.

After you have set the lower limit, the AQ2140 enters the standby mode. Press the [RUN/STOP] key to start alignment.

To cancel the currently running application, press the [SHIFT] key. The initial application selection screen (see Figure 5-12) will reappear.

5.5 Control via GPIB Interface (IEEE-488 Standards)

Your AQ2140 has the built-in GPIB interface to control each parameter setup, parameter modification, and data transmission and reception via the GPIB interface bus.

The AQ2140 uses an IEEE-486 standard, receptacle-type connector for signal interfacing.

CAUTION

Turn the ([POWER]) switch [■ OFF] before connecting or disconnecting the GPIB interface cable.

When you turns the power switch ON, the AQ2140 executes the lamp test and memory test. During this time (approximately 10 seconds), the AQ2140 cannot accept the GPIB program codes.

5.5.1 Interface functions

Table 5-5 GPIB Interface Functions

Function	Explanation
SH1	Source handshaking full functions
AH1	Acceptor handshaking full functions
T7	Talker function
L4	Listener function
SR1	Service request
RL1	Remote/local control
PP0	No parallel polling
DC1	Device clear
DT1	Device trigger
C0	No control functions
E1	Open collector driver

5.5.2 Explanation of basic functions

(1) GPIB address

You can change the GPIB address of your AQ2140 in the Parameter Setup mode (see Section 5.4.1). The new address is valid immediately after you have changed it. The setup address is kept by the battery. However, when the backup battery has expired or when the backup data is erased, the address data is lost and the GPIB address is reset to the initial setup. The initial GPIB address is "19".

(2) Local mode

When you control your AQ2140 from its operation keys, the Multimeter is in the Local mode. During this time, all operation keys are valid.

(3) Remote mode

When you control your AQ2140 from another controller via the GPIB interface bus, the Multimeter is in the Remote mode. During this time, all operation keys (except [LOCAL] key) are invalid. During Remote mode, the RMT lamp continues to light at the right upper end of the screen.

(4) LLO (Local Lockout)

When receiving the "LLO" universal command during Remote mode, the AQ2140 enters the LLO mode. During this time, all operation keys (including the [LOCAL] key) are invalid. To release this mode, use the REN (Remote Enable) command.

(5) DCL (Device Clear)

When receiving the "DCL" universal command or "SDC" address command during Remote mode, the AQ2140 initializes the parameters listed on Table 5-6.

CAUTION

During zero-adjustment (Zero Set), the DCL (Device Clear) command is ignored. The controller may stop handshaking if various commands, program codes or others are executed immediately after DCL command. To prevent it, set a 100 msec waiting immediately after the DCL.

(6) GET (Group Trigger)

When receiving the "GET" address command during Remote mode, the AQ2140 starts a single-time measurement.

(7) The operating range supported in Remote mode

The AQ2140 supports the remote operations which are similar to those available in the manual operations. For details, see Section 5.5.3 "Program codes."

(8) Send/receive buffer

The AQ2140 has a 128-byte send/receive buffer.

Table 5-6 Parameters Initialized by Device Clear

Parameter	Initial value	Application
Service request	Full masking	
Measurement unit	dBm	Sensor
Range setup	Auto range	Sensor
Averaging	Off	Sensor
Display resolution	1/1000	Sensor
Measurement interval	100 msec	Sensor
Calibration value	0.000 dB	Sensor
Reference value	0.000 dBm	Sensor
Optical modulation mode	CW	Sensor or Light Source
Optical output	Off	Light Source
Optical attenuation	0.0 dB	Light Source
Measurement	Continuous measurement	Sensor
Output data setup	Measurement data	

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5.5.3 Program codes

Some program codes may not function due to the unit type or measurement parameters for the mounted unit.

Table 5-7 GPIB Program Codes
(Application: I for sensor unit, II for optical source, and III for common use)

Function	Explanation	Program Code	Channel Setup	Application	Note
Service request	Full mask Separate mask	I0 I1 to I9, IA to IF	Not required	-	1
Channel setup	Channels A&B Channel A Channel B	C0 or C3 C1 C2	-	III	2
Unit Relative measurement	W dBm Display Reference measurement Channel Comparison measurement: A/B B/A Reference measurement: A/REF B/REF	FA FB FC FD1 FD2 or FD FF1 FF2	Required Not required	I	
Maximum and minimum value measurement	Stop Start	H0 H1	Required	I	3
Range setup	AUTO 30 dBm (1W) 20 dBm (100mW) 10 dBm (10mW) 0 dBm (1mW) -10 dBm (100μW) -20 dBm (10μW) -30 dBm (1μW) -40 dBm (100nW) -50 dBm (10nW) -60 dBm (1nW) -70 dBm (100pW) -80 dBm (10pW) -90 dBm (1pW)	RA RC RD RE RF RG RH RI RJ RK RL RM RN RO	Required	I	4
Zero Set	ON (Separate operation)	Z	Required	I	5

Function	Explanation	Program Code	Channel Setup	Application	Note
Averaging (AVG)	1 (OFF) 2 5 10 20 50 100 200	AA AB AC AD AE AF AG AH	Required	I	5
Display resolution	1/1000 1/100 1/10	B0 B1 B2	Required	I	
Beep tone	1 to 16 tone levels	TO××	Not required	–	
Beep volume	0 to 4 volume levels	VO×	Not required	–	
Display intensity	1 to 4 brightness levels	BR×	Not required	–	
Measurement interval	10 msec 20 msec 50 msec 100 msec	TA7 TA8 TA9 TAA	Not required	–	6
Calibration (CAL F)	dB=±×××.××××	D±×××.×××	Required	I	
Reference values (REF)	dBm=±×××.××× W=×.××× mW=×××.××× μW=×××.××× nW=×××.××× pW=×××.×××	R±×××.×××DB R+×.×××W R+×××.×××MW R+×××.×××UW R+×××.×××NW R+×××.×××PW	Required	I	
Calibration wavelength (λ)	WL= ×××× nm	W××××	Required	I	
Optical modulation mode	CW 270 Hz 1 kHz 2 kHz	MO0 or C MO1 or P MO2 MO3	Required	III	

Function	Explanation	Program Code	Channel Setup	Application	Note
Optical output	OFF ON	OO O1	Required	II	
Optical attenuation (ATT)	0.0 to 6.0 dB Clear	ATL×× ATC	Required	II	
Optical source selection (for dual sources)	λ = 1 λ = 2 λ = 1 、 2	WL1 WL2 WL3	Required	II	
Measurement	Single-time measurement Continuous measurement	S or GET Trigger F	Required	I	
Output data setup (Sensor)	Measurement data: Channels A&B Channel A Channel B Parameters: Channel A Channel B Reference values: Channels A&B Channel A Channel B Maximum and minmum values: Channels A&B Channel A Channel B	 OD0 or OD3 OD1 OD2 OS1 OS2 FR0 or FR3 FR1 FR2 HD0/MAX/MIN or HD3/MAX/MIN HD1/MAX/MIN HD2/MAX/MIN	Not required	I	
Output data setup (Optical source)	Parameters: Channel A Channel B	 LSS1 LSS2	Not required	II	

NOTE 1· An "SRQ" (Service Request) occurs during the following:

① *TEST ERROR*
The Zero Set (zero-adjustment) has failed.

② *TEST END*
The Zero Set (zero-adjustment) has terminated normally.

③ *ERROR*
An error (see Table 5-9) has occurred.

④ *DATA READY*
The data is ready to send after the OD command reception.

The SRQ status byte (STB) has the following format:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
×	RQS	×	×	Test Error	Test End	Error	Data Ready

- RQS
  Bits 0 to 3 go high (logical 1) when masked, and to high (logical 1) when set.
- Error
  Set to logical 1 when Zero Set has failed.
- Test End
  Set to logical 1 when Zero Set has terminated normally.
- Program Error
  Set to logical 1 when an error (see Table 5-9) has occurred.
- Data Ready
  Set to logical 1 when the data is ready to send.

The service request function can be masked for each cause. The binary value of program codes 1 to 9 and A to F correspond to STB bits 3 to 0. The logical 1 bit is valid, but the logical 0 bit is invalid.

Example: Program code 15
Decimal value "5" is equal to binary value "0101" . Bit 2 and bit 0 are valid, but bit 3 and bit 1 are invalid.
Therefore, when a Test End or a Data Ready occurs, a service request is issued to the controller. However, when a Test Error or an Error occurs, no service request is issued to the controller.

Example: Program code IF
Decimal value "F" is equal to binary value " 1111" . All bits are valid.

When the mask conditions of service request are changed, the status byte is cleared. If a service request is issued to the controller, this request is canceled.

Example: If a service request is set by program code I1 and if a Data Ready has occurred:
Bit 0 and bit 6 are set to logical 1, and a service request is issued to the controller. If this service request is ignored and if program code I2 is set, bit 0 and bit 6 are cleared. Therefore, the STB is set to 0 and the service request is canceled simultaneously.

NOTE 2: Your channel setup is held until the next setup. You need not repear to set for the same channel. However, you must set the channel when changing to another channel.

NOTE3: When "H1" code is received again during maximum and minimum value measurement, the maximum and minimum value is reset.
The maximum and minimum value is reset at the same time as transmitting the maximum and minimum value data to the controller when the command of the output of the data of the maximum and minimum value is received.

When the command of the output of the data of the maximum and minimum value is received during not measuring in the maximum and minimum, unit W and data 000.000 are transmitted.

NOTE4: The range setup usually takes approximately 500 msec. Also, the measurement may be unstable immediately after this setup. To prevent such problems, perform a dummy measurement using "S" code or others at least one time after range setup. Then, start the normal measurement.

NOTE5: During Zero Set (zero-adjustment), the AQ2140 cannot accept all commands and codes except for Device Clear. Also, if bit 3 or bit 1 of service request is NOT masked and if a Zero Set Error occurs, the service request continues approximately 3 seconds.

NOTE6: The averaging processing uses the sequential addition averaging method (see Section 5.3.6). Therefore, the measured data immediately after the averaging has turned ON are not averaged sufficiently.

NOTE7: If two Sensor Units are connected to your AQ2140, the minimum measurement interval is set to 20 msec. Therefore, the "TA7" setup is made invalid. If only a single Sensor Unit is connected to the AQ2140, the minimum measurement interval is set to 10 msec and the "TA8" setup is made invalid.

5.5.4 Programming rules

a. The program codes can be sent with together when connected to each other by a comma (,).

b. The total number of characters except blanks (but including CR, LF and other control codes) is 100 characters.

c. The delimiters are CR and LF only.

d. The channel setup is held until the next setup.

e. Unnecessary zeros (0s) may be omitted in the numerical input section of codes (such as "××.×××").
Example: For "D+001.000DB" input:
Simply enter "D+1DB".

f. Calibration wavelength "W××××" cannot exceed the range set by the specifications.

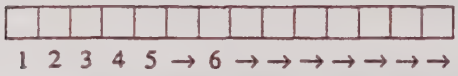
g. The correction values can be entered within the following ranges:
-99.999 dB to +99.999 dB (or dBm)
0.010 pW to 1.000W

5.5.5 Output formats

The output data must end with a CR or LF control code.

(1) If the output data is OD or FR command:

Single-channel data output format



Two-channel data output format

Table 5-8 GPIB Data Output Formats (1)

1	Output channel	A: Channel A B: Channel B
2	Status	Z: During Zero Set I: Within the range U: Under range O: Over range R: During range change C: Reference value (during FR command)
3	Function information	1: W 2: W-REF 3: W-A/B (or W-B/A) A: dBm B: dBm-REF C: dBm-A/B (or dBm-B/A)
4	Measurement unit	O: W P: mW Q: μW R: nW S: pW U: dBm V: dB W: No measurement unit
5	Range information	Same as the program code
6	Data	Signed 7-digit output (in 0.001 display resolution)

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(2) If the output data is HD command:

Single-channel data output format

Two-channel data output format

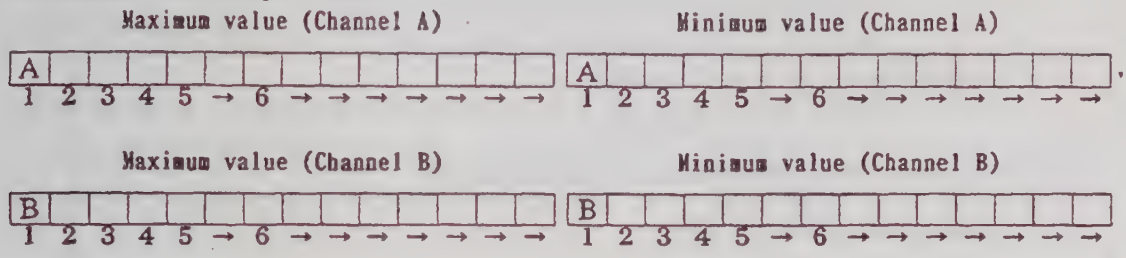

Maximum value (Channel A)
Minimum value (Channel A)
A
1 2 3 4 5 → 6 → → → → → → →
A
1 2 3 4 5 → 6 → → → → → → →
Maximum value (Channel B)
Minimum value (Channel B)
B
1 2 3 4 5 → 6 → → → → → → →
B
1 2 3 4 5 → 6 → → → → → → →

Table 5-8 GPIB Data Output Formats (2)

1	Output channel	A: Channel A B: Channel B
2	Status	Z: During Zero Set I: Within the range U: Under range O: Over range R: During range change C: Reference value (during FR command)
3	Function information	1: W 2: W-REF 3: W-A/B (or W-B/A) A: dBm B: dBm-REF C: dBm-A/B (or dBm-B/A)
4	Measurement unit	O: W P: mW Q: μW R: nW S: pW U: dBm V: dB W: No measurement unit
5	Range information	Same as the program code
6	Data	Signed 7-digit output (in 0.001 display resolution)

(3) If the output data is OS command:

Data output format

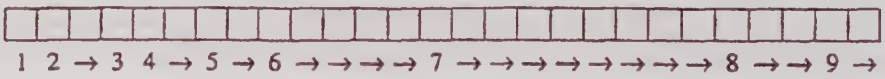


Table 5-8 GPIB Data Output Formats (3)

1	Output channel	A: Channel A B: Channel B
2	Channel specified	Same as the program code
3	Optical signal format	C: CW P: 270 Hz Q: 1 kHz R: 2 kHz
4	Function information	F1: W F2: W-REF F3: W-A/B (or W-B/A) FA: dBm FB: dBm-REF FC: dBm-A/B (or dBm-B/A)
5	Averaging	Same as the program code
6	Calibration wavelength	Same as above
7	Correction value	Same as above
8	Measurement interval	Same as above
9	Range information	Same as above

(4) If the output data is LSS command:

① The data output format if it is not Dual optical source.
② The data output format when only λ=1 is selected in Dual optical source.
③ The data output format when only λ=2 is selected in Dual optical source.

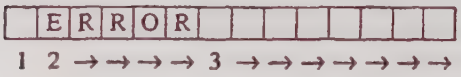
④ The data output format when selected with both of λ=1, 2 Dual optical source.

Table 5-8 GPIB Data Output Formats (4)

1	Output channel	A: Channel A B: Channel B
2	Channel specified	Same as the program code
3	Optical source type	LDS: Single LD source LDD: Dual LD sources LES: LED source
4	Optical source ON/OFF setup	Same as the program code
5	Optical signal format	C: CW P: 270 Hz Q: 1kHz R: 2 kHz
6	Optical attenuation	Same as the program code
7	Optical emission wavelength	WXXXX.X The wavelength of λ=1 is shown for above-mentioned ②. The wavelength of λ=2 is shown for above-mentioned ③. The wavelength of λ=1 is shown for above-mentioned ④.
8	Optical emission wavelength (only above-mentioned ④)	WYYYY.Y The wavelength of λ=2 is shown for above-mentioned ④.

(4) Error format

Single-channel data output format



Two-channel data output format

Table 5-9 GPIB Error Output Format

1	Output channel	A: Channel A B: Channel B
2	Status	Error
3	Error information	1: The unit was removed during its operation. 2: An inoperable program code was received. 3: A value exceeding the display limit was detected. 4: The wavelength exceeding the unit operating range was set. 5: The zero-adjustment (Zero Set) has failed. 6: Too many codes were received. 7: The optical modulation mode is incorrect.

If duplicate errors have occurred, an error message similar to the following one is output:

"AERROR00000123"

If error 2 or 6 has occurred, no channel number is displayed.

5.5.6 Sample program

The following gives an sample program to perform a single-time measurement and display the measured data on the controller.

Example: The Hewlett Packard's HP9836 controller is used, two sensors are connected to the AQ2140 Optical Multimeter, and the GPIB address is set to "19".

```
10  DIM A$ [30]
20  ABORT 7
30  OUTPUT 719;"OD0, S"
40  ENTER 719;A$
50  PRINT A$
60  LOCAL 7
70  END
```

5.6 Error Messages

If your operating conditions are incorrect, the AQ2140 displays error messages that are listed on Table 5-10. If it has occurred, locate the error cause and take an appropriate action.

Table 5-10 Error Messages

No.	Error Code	Explanation	Actions Taken
1	ERR01	RAM error of AQ2140	Call the service to repair your AQ2140.
2	ERR02	Expired service life of backup battery	Replace the backup battery with a new one. Press the ENTER key to restart the Multimeter. (However, the data CANNOT be backed up.)
3	ERR03	Unit RAM error	Call the service to repair the unit.
4	ERR04	Disconnected sensor(s)	Connect the sensor(s) to the AQ2140 securely.
5	ERR05	Unit mounting error	An illegal unit has been connected to the AQ2140. Check the unit.
6	ERR11	Unit removal	Turn the AQ2140 power switch OFF first, then turn it ON again.
7	ERR12	Zero Set error	Shield the photosensor from ambient light, and repeat the zero-adjustment.
8	ERR13	Optical modulation mode error	Select the correct optical modulation mode.

6. Structure and Circuits of Optical Multimeter

This chapter outlines the basic circuit configuration and structure of the AQ2140.

6.1 Circuit Configuration

Figure 6-1 gives a circuit block diagram of the AQ2140. The AQ2140 controls the key operations and GPIB command transmission to the unit(s). Also, it receives digital data from the Sensor Unit(s), processes them by various arithmetic operations, and displays them on the fluorescent lamp display.

(1) Control section
Your key operations and GPIB commands are converted into the format that each unit can recognize within the AQ2140. The converted data is sent to the respective Units via the serial bus. The Light Source Unit converts the optical output by following the commands issued by the AQ2140. The Sensor Unit converts the incident light into digital data by following the control command issued by the AQ2140. Then, the Sensor Unit converts them into the format that the AQ2140 can recognize, and sends them to the AQ2140 via the serial bus.

(2) Display section
The display section receives the measured data from the Sensor Unit(s), and displays the status information of the AQ2140 and each unit via the display circuit.

6.2 System Structure

The appearance of the AQ2140 is shown on drawings ASD-62333.

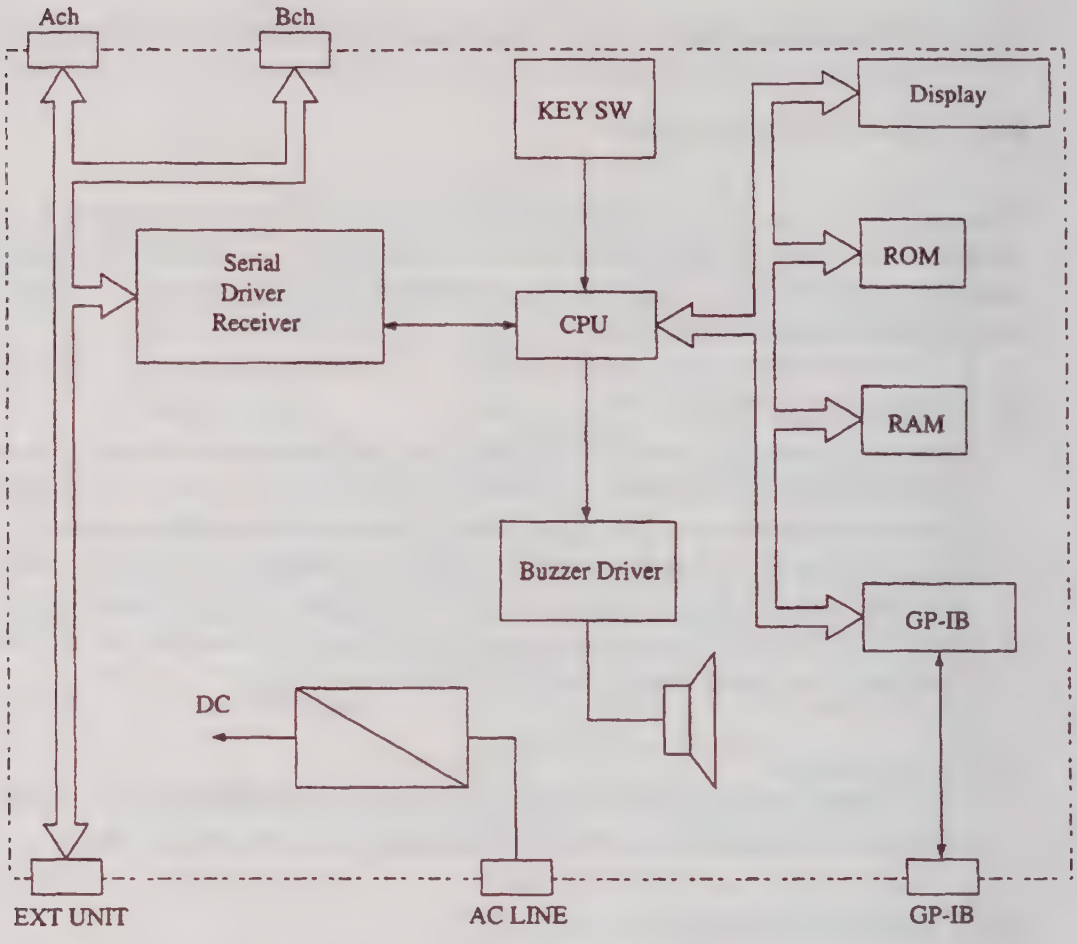


Figure 6-1 Circuit Configuration of AQ2140

7. Troubleshooting Guide

This chapter gives the basic checkpoints that you should use if your AQ2140 has failed.

(1) The AQ2140 does not operate after power ON.

- Check the power fuse at the AQ2140 rear panel.

(2) The absolute value is incorrect.

- Check the calibration wavelength.
- Check the correction values.
- Check the optical modulation mode of the Light Source and the optical modulation mode of the Sensor Unit.

(3) The ERR13 error message is displayed.

- If the CHOP optical modulation mode is selected for the Sensor Unit, the optical noise that is greater than –60 dBm can cause an error. Shield the photosensor from the ambient light.

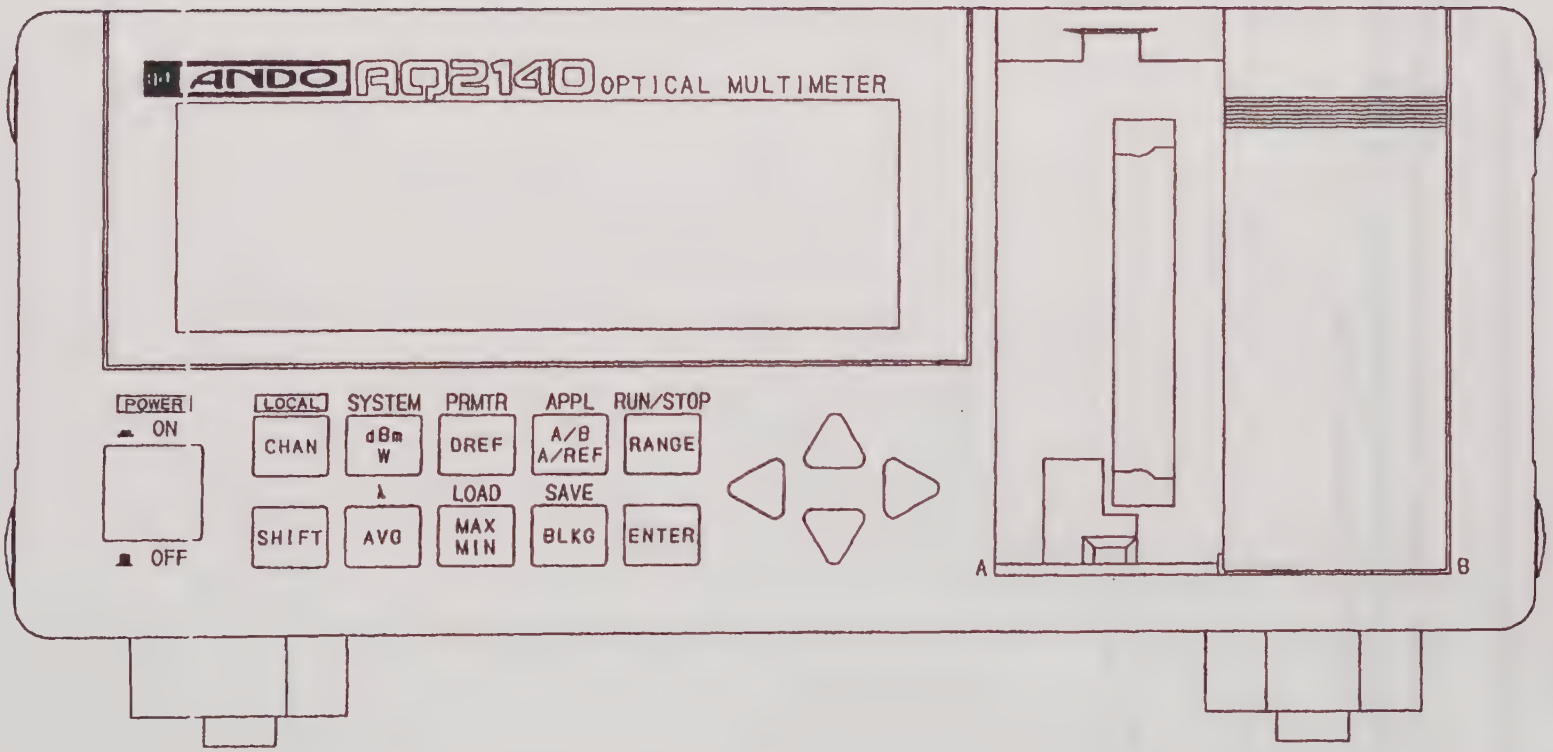
(4) The [CHAN] key does not function.

- If only a single Unit is connected to the AQ2140, the [CHAN] key is invalid.

8. Maintenance

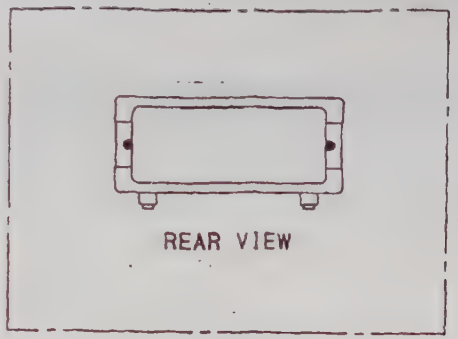
This chapter describes the standard system maintenance and service procedure.

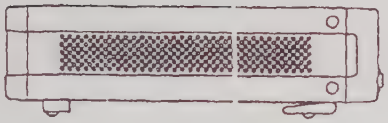
As your AQ2140 is a controller to control the dedicate system units, you need not maintain your AQ2140 separately. The actual Unit maintenance varies depending on the units used. Follow the separate Unit instruction manuals.



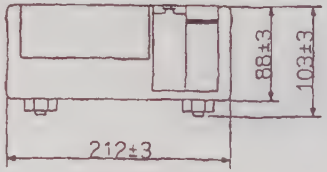
OUTSIDE VIEW OF AQ2140 OPTICAL MULTIMETER (FRONT VIEW

TOP VIEW

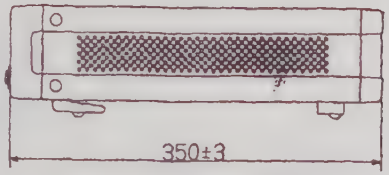




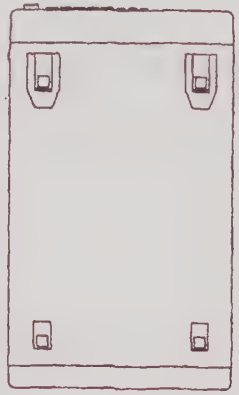
LEFT SIDE VIEW



FRONT VIEW



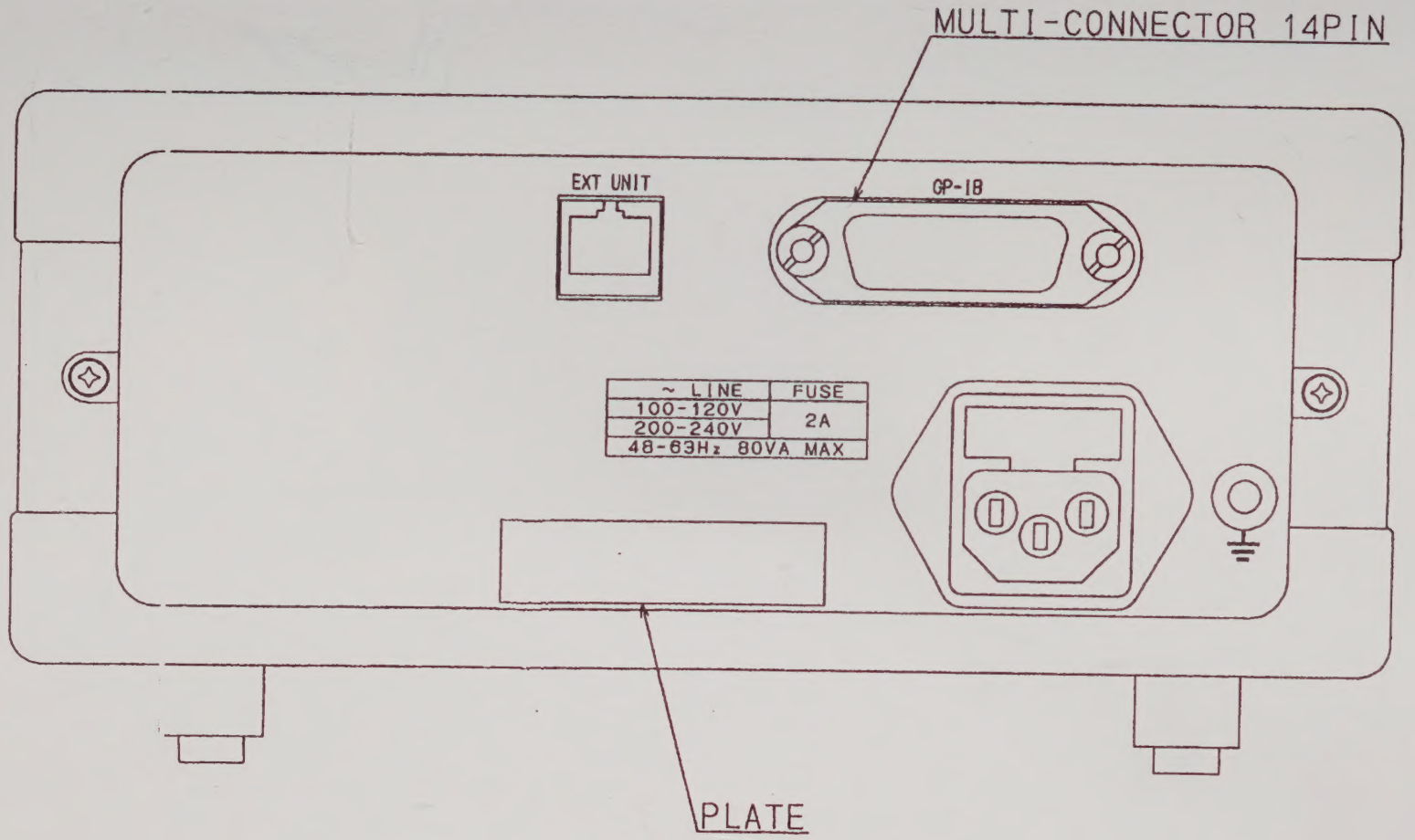
RIGHT SIDE VIEW



BOTTOM VIEW

DIMENSION SHOWN IN mm

OUTSIDE VIEW OF AQ2140 OPTICAL MULTIMETER



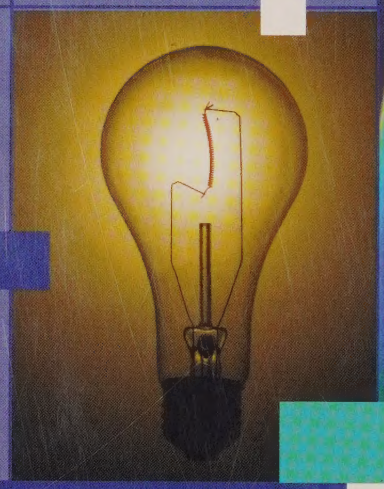
OUTSIDE VIEW OF AQ2140 OPTICAL MULTIMETER (REAR VIEW

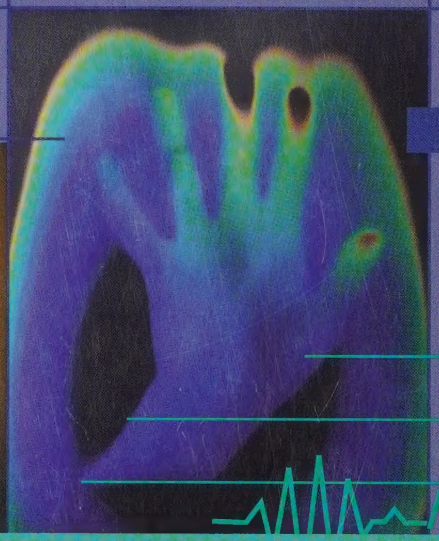
ASD-6233

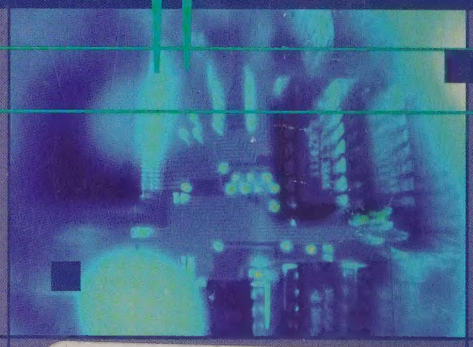
OUTSIDE VIEW OF VOSJAO OPTICAL MULTIMETER (REAR VIEW)

V20-6581

METRIC







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